

DIVISION 8 MISCELLANEOUS CONSTRUCTION

8-01 EROSION CONTROL AND WATER POLLUTION CONTROL

8-01.1 Description

This Work consists of furnishing, installing, maintaining, removing and disposing of high visibility fence, and water pollution and erosion control items in accordance with these Specifications and as shown in the Plans or as designated by the Engineer.

8-01.2 Materials

Materials shall meet the requirements of the following sections:

Seed	9-14.2
Fertilizer	9-14.3
Mulch and Amendments	9-14.4
Erosion Control Devices	9-14.5
High Visibility Fence	9-14.5
Construction Geotextile	9-33
Quarry Spalls	9-13

8-01.3 Construction Requirements

8-01.3(1) General

The Contractor shall install a high visibility fence along the site preservation lines shown in the Plans or as instructed by the Engineer. Post spacing and attachment of the fence fabric to the posts shall be as shown in the Plans. The fence shall not be fastened to trees.

Throughout the life of the project, the Contractor shall preserve and protect the delineated area, acting immediately to repair or restore any fencing damaged or removed.

Controlling pollution, erosion, runoff, and related damage requires the Contractor to perform temporary Work items including but not limited to:

1. Providing ditches, berms, culverts, and other measures to control surface water;
2. Building dams, settling basins, energy dissipaters, and other measures, to control downstream flows;
3. Controlling underground water found during construction; or
4. Covering or otherwise protecting slopes until permanent erosion-control measures are working.

To the degree possible, the Contractor shall coordinate this temporary Work with permanent drainage and erosion control Work the Contract requires.

The Engineer may require additional temporary control measures if it appears pollution or erosion may result from weather, the nature of the materials, or progress on the Work.

When natural elements rut or erode the slope, the Contractor shall restore and repair the damage with the eroded material where possible, and clean up any remaining material in ditches and culverts. When the Engineer orders replacement with additional or other materials, unit Contract prices will cover the quantities needed.

If the Engineer anticipates water pollution or erosion, the Contractor shall schedule the Work so that grading and erosion control immediately follows clearing and grubbing. The Engineer may also require erosion control Work to be done with or immediately after grading. All sediment control devices including, but not limited to, sediment ponds,

perimeter silt fencing, or other sediment trapping BMPs shall be installed prior to any ground disturbing activity. Clearing, grubbing, excavation, borrow, or fill within the Right of Way shall never expose more erodible earth than as listed below, without written approval by the Engineer:

Area	Date	Location
17 Acres	April 1 - October 31	East of the Summit of the Cascade Range
	May 1 - September 30	West of the Summit of the Cascade Range
5 Acres	November 1 - March 31	East of the Summit of the Cascade Range
	October 1 - April 30	West of the Summit of the Cascade Range

The Engineer may increase or decrease the limits in light of project conditions.

Erodible earth is defined as any surface where soils, grindings, or other materials are capable of being displaced and transported by rain, wind, or surface water runoff.

Erodible earth not being worked, whether at final grade or not, shall be covered within the specified time period, using an approved soil covering practice.

In western Washington (west of the Cascade Mountain crest):

October 1 through April 30 2-days maximum

May 1 to September 30 7-days maximum

In eastern Washington (east of the Cascade Mountain crest.):

October 1 through June 30 5-days maximum

July 1 through September 30 10-days maximum

If the Engineer, under Section 1-08.6, orders the Work suspended, the Contractor shall continue to control erosion, pollution, and runoff during the shutdown.

Nothing in this section shall relieve the Contractor from complying with other Contract requirements.

8-01.3(1)A Submittals

When a temporary erosion and sediment control (TESC) Plan is included in the Plans, the Contractor shall either adopt or modify the existing TESC Plan. If modified, the Contractor's TESC Plan shall meet all requirements of Chapter 6, Section 6-2 of the current edition of the *WSDOT Highway Runoff Manual*. The Contractor shall provide a schedule for TESC Plan implementation and incorporate it into the Contractor's progress schedule. The Contractor shall obtain the Engineer's approval of the TESC Plan and schedule before any Work begins. The TESC Plan shall cover all areas the Contractor's Work may affect inside and outside the limits of the project (including all Contracting Agency-provided sources, disposal sites, and haul roads, and all nearby land, streams, and other bodies of water).

The Contractor shall allow at least 5-working days for the Engineer's review of any original or revised Plan. Failure to approve all or part of any such Plan shall not make the Contracting Agency liable to the Contractor for any Work delays.

8-01.3(1)B Erosion and Sediment Control (ESC) Lead

The Contractor shall identify the ESC Lead at the preconstruction discussions and in the TESC Plan. The ESC Lead shall have, for the life of the Contract, a current Certificate of Training in Construction Site Erosion and Sediment Control from a course approved by the Washington State Department of Ecology. The ESC Lead shall be listed on the Emergency Contact List required under Section 1-05.13(1).

The ESC Lead shall implement the Temporary Erosion and Sediment Control (TESC) Plan. Implementation shall include, but is not limited to:

1. Installing and maintaining all temporary erosion and sediment control Best Management Practices (BMPs) included in the TESC Plan to assure continued performance of their intended function. Damaged or inadequate TESC BMP's shall be corrected immediately.
2. Updating the TESC Plan to reflect current field conditions.

When a TESC Plan is included in the Contract Plans, the Contractor shall inspect all on-site erosion and sediment control BMP's at least once every calendar week and within 24-hours of runoff events in which stormwater discharges from the site. Inspections of temporarily stabilized, inactive sites may be reduced to once every calendar month. The Erosion and Sediment Control Inspection Form (Form Number 220-030 EF) shall be completed for each inspection and a copy shall be submitted to the Engineer no later than the end of the next working day following the inspection.

8-01.3(1)C Water Management

Unless site water is to be managed in accordance with the conditions of a waste discharge permit from a local permitting authority, site water shall be managed as follows:

1. Ground Water

When ground water is encountered in an excavation, it shall be treated and discharged as follows:

- a. When the ground water conforms to Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC), it may bypass detention and treatment facilities and be routed directly to its normal discharge point at a rate and method that will not cause erosion.
- b. When the turbidity of the ground water is similar to the turbidity of the site runoff, the ground water may be treated using the same detention and treatment facilities being used to treat the site runoff and then discharged at a rate that will not cause erosion.
- c. When the turbidity is greater than the turbidity of the site runoff, the ground water shall be treated separately until the turbidity is similar to or better than the site runoff, and then may be combined and treated as in B, above.

2. Process Water

High pH process water or wastewater (nonstormwater) that is generated on-site, including water generated during concrete grinding, rubblizing, washout, and hydrodemolition activities, shall not be discharged to waters of the State, including wetlands. Water may be infiltrated upon the approval of the Engineer. Off-site disposal of concrete process water shall be in accordance with Standard Specification 5-01.3(11).

All water generated on site from construction or washing activities that is more turbid than site runoff shall be treated separately until the turbidity is the same or less than the site runoff, and then may be combined and treated as in 1B, above. Water may be infiltrated upon the approval of the Engineer.

3. Offsite Water

The Contractor shall, prior to disruption of the normal watercourse, intercept the offsite stormwater and pipe it either through or around the project site. This water shall not be combined with onsite stormwater and shall be discharged at its pre-construction outfall point in such a manner that there is no increase in erosion below the site. The method for performing this Work shall be submitted by the Contractor for the Engineer's approval.

8-01.3(1)D Dispersion/Infiltration

Water shall be conveyed only to dispersion or infiltration areas designated in the TESC Plan or to sites approved by the Engineer. Water shall be conveyed to designated dispersion areas at a rate such that if runoff leaves the area and enters waters of the State, turbidity standards are met. Water shall be conveyed to designated infiltration areas at a rate that does not produce surface runoff.

8-01.3(1)E Detention/Retention Pond Construction

Whether permanent or temporary, ponds shall be constructed before beginning other grading and excavation Work in the area that drains into that pond. Temporary conveyances shall be installed concurrently with grading in accordance with the TESC Plan so that newly graded areas drain to the pond as they are exposed.

8-01.3(2) Seeding, Fertilizing, and Mulching**8-01.3(2)A Preparation For Application****Seeding**

Areas to be cultivated are shown in the Plans or specified in the Special Provisions. The areas shall be cultivated to the depths specified to provide a reasonably firm but friable seedbed. Cultivation shall take place no sooner than 2-weeks prior to seeding.

All areas to be seeded, including excavated slopes shall be compacted and prepared unless otherwise specified or ordered by the Engineer. A cleated roller, crawler tractor, or similar equipment, approved by the Engineer that forms longitudinal depressions at least 2-inches deep shall be used for compaction and preparation of the surface to be seeded.

The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope. The soil shall be conditioned with sufficient water so the longitudinal depressions remain in the soil surface until completion of the seeding.

Prior to seeding, the finished grade of the soil shall be 1-inch below the top of all curbs, junction and valve boxes, walks, driveways, and other Structures. The soil shall be in a weed free and bare condition.

Temporary Seeding

A cleated roller, crawler tractor, or similar equipment, approved by the Engineer that forms longitudinal depressions at least 2-inches deep shall be used for compaction and preparation of the surface to be seeded. The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope. The soil shall be conditioned with sufficient water so the longitudinal depressions remain in the soil surface until completion of the seeding.

8-01.3(2)B Seeding and Fertilizing

Seed or seed and fertilizer shall be placed at the rate, mix and analysis specified in the Special Provisions or as designated by the Engineer. The Contractor shall notify the Engineer not less than 24-hours in advance of any seeding operation and shall not begin the Work until areas prepared or designated for seeding have been approved. Following the Engineer's approval, seeding of the approved slopes shall begin immediately.

Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable. Seed or seed and fertilizer may be sown by 1 of the following methods:

1. An approved hydro seeder that utilizes water as the carrying agent, and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into a homogeneous slurry the specified amount of seed and water or other material. Distribution and

discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles that will provide a uniform distribution of the slurry.

2. Approved blower equipment with an adjustable disseminating device capable of maintaining a constant, measured rate of material discharge that will ensure an even distribution of seed at the rates specified.
3. Helicopters properly equipped for aerial seeding.
4. Approved power-drawn drills or seeders.
5. Areas in which the above methods are impractical may be seeded by approved hand methods.

When seeding by hand, the seed shall be incorporated into the top ¼-inch of soil by hand raking or other method that is approved by the Engineer.

The seed applied using a hydroseeder shall have a tracer added to visibly aid uniform application. This tracer shall not be harmful to plant and animal life. If wood cellulose fiber is used as a tracer, the application rate shall not exceed 250-pounds per acre.

Seed and fertilizer may be applied in 1 application provided that the fertilizer is placed in the hydro seeder tank no more than 1-hour prior to application.

8-01.3(2)C Liming

Agricultural lime shall be applied at the rates specified in the Special Provisions.

The method of application shall be in conformance with all air and water pollution regulations and shall be approved by the Engineer.

8-01.3(2)D Mulching

Mulch of the type specified in the Special Provisions shall be furnished, hauled, and evenly applied at the rates indicated and shall be spread on seeded areas within 48-hours after seeding unless otherwise specified.

Distribution of straw mulch material shall be by means of an approved mulch spreader that utilizes forced air to blow mulch material on seeded areas. Wood strand mulch shall be applied by hand or by straw blower.

Mulch may be applied with seed and fertilizer West of the summit of the Cascade Range. East of the summit of the Cascade Range, seed and fertilizer shall be applied in 1 application followed by the application of mulch. Mulch shall be suitable for application with a hydro seeder as specified in Section 8-01.3(2)B.

Temporary seed applied outside the application windows established in 8-01.3(2) F, shall be covered with a mulch containing either BFM or MBFM, as designated by the Engineer.

Mulch sprayed on signs or sign Structures shall be removed the same day.

Areas not accessible by mulching equipment shall be mulched by approved hand methods.

8-01.3(2)E Tacking Agent and Soil Binders

Tacking Agents

Tacking agents shall be applied in accordance with the manufacturer's recommended requirements.

Soil Binders

Soil binders shall be applied in accordance with the manufacturer's recommended requirements.

Soil Binding Using Polyacrylamide (PAM)

The PAM shall be applied on bare soil completely dissolved and mixed in water or applied as a dry powder. Dissolved PAM shall be applied at a rate of not more than $\frac{2}{3}$ -pound per 1,000-gallons of water per acre. A minimum of 200-pounds per acre of cellulose fiber mulch treated with a non-toxic dye shall be applied with the dissolved PAM. Dry powder applications may be at a rate of 5-pounds per acre using a hand-held fertilizer spreader or a tractor-mounted spreader.

PAM shall be applied only to areas that drain to completed sedimentation control BMPs in accordance with the TESC Plan. PAM may be reapplied on actively worked areas within a 48-hour period.

PAM shall not be applied during rainfall or to saturated soils.

Soil Binding Using Bonded Fiber Matrix (BFM)

The BFM shall be hydraulically applied in accordance with the manufacturer's installation instructions.

Soil Binding Using Mechanically-Bonded Fiber Matrix (MBFM)

The MBFM shall be hydraulically applied in accordance with the manufacturer's installation instructions and recommendations.

8-01.3(2)F Dates for Application of Final Seed, Fertilizer, and Mulch

Unless otherwise approved by the Engineer, the final application of seeding, fertilizing, and mulching of slopes shall be performed during the following periods:

West of the summit of the Cascade Range - March 1 to May 15 and September 1 to October 1. Where Contract timing is appropriate, seeding, fertilizing, and mulching shall be accomplished during the fall period listed above. Written permission to seed after October 1 will only be given when Physical Completion of the project is imminent and the environmental conditions are conducive to satisfactory growth.

East of the summit of the Cascade Range - October 1 to November 15.

Seeding, fertilizing, and mulching shall be accomplished during this fall period only.

All Roadway excavation and embankment slopes, including excavation and embankment slopes that are partially completed to grade, shall be prepared and seeded during the first available seeding window. When environmental conditions are not conducive to satisfactory results, the Engineer may suspend Work until such time that the desired results are likely to be obtained.

When environmental conditions are conducive to satisfactory results, the Contractor may elect to perform seeding operations outside of the time periods specified. Inspection of seeding performed at the Contractor's option outside of the time periods specified will be made after 1 growing season has elapsed. Acceptance will be based on a uniform stand of grass at the time of inspection. The Contractor shall restore eroded areas, clean up eroded materials, and reseed, fertilize, and mulch, at no additional cost to the Contracting Agency, the areas failing to show a uniform stand of grass.

Temporary seeding may be performed at any time approved by the Engineer.

8-01.3(2)G Protection and Care of Seeded Areas

The Contractor shall be responsible to ensure a healthy stand of grass, otherwise, the Contractor shall restore eroded areas, clean up eroded materials, and reapply the seed, fertilizer, and mulch, at no additional cost to the Contracting Agency.

In addition to the requirements of Section 1-07.13(1), the Contractor shall be responsible for performing the following duties:

1. Areas which have been damaged through any cause prior to final inspection, and areas failing to receive a uniform application at the specified rate, shall be reseeded, refertilized, and remulched at the Contractor's expense.
2. Seeded areas within the planting area shall be considered part of the planting area. Weeds within the seeded areas shall be controlled in accordance with Section 8-02.3(3).

8-01.3(2)H Inspection

Inspection of seeded areas will be made upon completion of seeding, fertilizing, temporary seeding, and mulching. The Work in any area will not be measured for payment until a uniform distribution of the materials is accomplished at the specified rate. Areas not receiving a uniform application of seed, fertilizer, or mulch at the specified rate, as determined by the Engineer, shall be reseeded, refertilized, or remulched at the Contractor's expense prior to payment.

8-01.3(2)I Mowing

When the Proposal contains the Bid item "Mowing" or mowing areas are defined, the Contractor shall mow all grass growing areas and slopes 2.5 (H) to 1 (V) or flatter except for naturally wooded and undergrowth areas. Trimming around traffic facilities, Structures, planting areas, or other features extending above ground shall be accomplished preceding or simultaneously with each mowing by use of power driven or hand operated machinery and tools to achieve a neat and uniform appearance.

Each mowing shall be considered as 1 coverage of all grass areas to be mowed within a defined area. Prospective Bidders shall verify the estimated acreage, the topography, irregularity of the area, slopes involved, and access limitations to determine the appropriate equipment to use for mowing. Equipment and tools shall be provided such as, but not limited to, tractor operated rotary or flail-type grass cutting machines and tools or other approved equipment. Power driven equipment shall not cause ruts or deformation of improved areas. Sickie type grass cutters will be permitted only on slopes of drainage ditches, berms, or other rough areas. The equipment and tools shall be in good repair and maintained so that a clean, sharp cut of the grass will result at all times. The Engineer will determine the actual number of mowings. The height of mowing will be 4 to 6-inches or as designated in the Plans or in the Special Provisions.

Mowing equipment shall be operated and equipped with suitable guards to prevent throwing rocks or debris onto the Traveled Way or off the Right of Way. Equipment, which pulls or rips the grass or damages the turf in any manner will not be permitted. The Engineer will be the sole judge of the adequacy of the equipment, safeguards, and methods of use. The Contractor will not be required to collect or remove clippings from the project except on the Traveled Way, Shoulder, walkway, or other areas designated by the Engineer.

8-01.3(3) Placing Erosion Control Blanket

The slope rating of the blanket, as specified by the manufacturer, shall be appropriate for the intended slope and installed according to the Standard Plans. Temporary erosion control blankets as defined in 9-14.5, having an open area of 60-percent or greater, may be installed prior to seeding. Blankets with less than 60-percent open space shall be installed immediately following the seeding and fertilizing operation.

8-01.3(4) Placing Compost Blanket

Compost blanket shall be placed to a depth of 3-inches over bare soil. Compost blanket shall be placed before seeding or other planting.

Compost shall be Coarse Compost and meet the requirements of 9-14.4(8).

8-01.3(5) Placing Plastic Covering

Plastic meeting the requirements of Section 9-14.5(3) shall be placed with at least a 12-inch overlap of all seams.

Clear plastic covering shall be used to promote growth of vegetation. Black plastic covering shall be used for stockpiles or other areas where vegetative growth is unwanted.

The cover shall be maintained tightly in place by using sandbags on ropes in a 10-foot, maximum, grid. All seams shall be weighted down full length.

8-01.3(6) Check Dams

Check dams shall be installed as soon as construction will allow, or when designated by the Engineer. The Contractor may substitute a different check dam for that specified with approval of the Engineer. Check dams shall be placed in ditches perpendicular to the channel. Check dams shall be of sufficient height to maximize detention, without causing water to leave the ditch.

8-01.3(6)A Geotextile-Encased Check Dam

The geotextile-encased check dam shall meet the requirements in Section 9-14.5(4) Geotextile-Encased Check Dam.

Installation of geotextile-encased check dams shall be in accordance with the Plans, and shall be anchored to hold it firmly in place under all conditions.

8-01.3(6)B Rock Check Dam

The rock used to construct rock check dams shall meet the requirements for quarry spalls, in accordance with Section 9-13.6.

8-01.3(6)C Sandbag Check Dam

Sandbags shall be placed so that the initial row makes tight contact with the ditch line for the length of the dam. Subsequent rows shall be staggered so the center of the bag is placed over the space between bags on the previous lift.

8-01.3(6)D Wattle Check Dam

Wattles used to construct wattle check dams shall meet the requirements for 9-14.5(5).

8-01.3(6)E Coir Log

Coir logs shall meet the requirements of 9-14.5(7) Coir Log . Install coir log as shown in the Plans.

8-01.3(7) Stabilized Construction Entrance

Temporary stabilized construction entrance shall be constructed in accordance with the Plans, prior to beginning any clearing, grubbing, earthwork or excavation.

When the stabilized entrance no longer prevents track out of sediment or debris, the Contractor shall either rehabilitate the existing entrance to original condition, or construct a new entrance.

When the Contract requires a tire wash in conjunction with the stabilized entrance, the Contractor shall include details for the tire wash and the method for containing and treating the sediment-laden runoff as part of the TESC Plan. All vehicles leaving the site shall stop and wash sediment from their tires.

8-01.3(8) Street Cleaning

Self-propelled pickup street sweepers shall be used, whenever required by the Engineer, to prevent the transport of sediment and other debris off the project site. Street sweepers shall be designed and operated to meet air quality standards.

Street washing with water will require approval by the Engineer.

8-01.3(9) Sediment Control Barriers

Sediment control barriers shall be installed in accordance with TESC Plan or manufacturer's recommendations in the areas of clearing, grubbing, earthwork or drainage prior to starting those activities.

The sediment control barriers shall be maintained until the soils are stabilized.

8-01.3(9)A Silt Fence

Silt fence shall be installed in accordance with the Plans.

When backup support is used, steel wire shall have a maximum mesh spacing of 2-inches by 4-inches, and the plastic mesh shall be as resistant to ultraviolet radiation as the geotextile it supports. The strength of the wire or plastic mesh shall be equivalent to or greater than that required in Table 6 for unsupported geotextile (i.e., 180 lbs. grab tensile strength).

The geotextile shall be attached to the posts and support system using staples, wire, or in accordance with the manufacturer's recommendations. Geotextile material shall meet the requirements of Section 9-33 Table 6.

The geotextile shall be sewn together at the point of manufacture, or at a location approved by the Engineer, to form geotextile lengths as required. All sewn seams and overlaps shall be located at a support post.

Posts shall be either wood or steel. Wood posts shall have minimum dimensions of 1¼-inches by 1¼-inches by the minimum length shown in the Plans. Steel posts shall have a minimum weight of 0.90 lbs/ft

When sediment deposits reach approximately ⅓ the height of the silt fence, the deposits shall be removed and stabilized in accordance with Section 8-01.3(15).

8-01.3(9)B Gravel Filter, Wood Chip or Compost Berm

The gravel filter berm shall be a minimum of 1-foot in height and shall be maintained at this height for the entire time they are in use.

The wood chip berm shall be a minimum of 2-feet in height and shall be maintained at this height for the entire time they are in use. Wood chips shall meet the requirements in Section 9-14.4(3).

The Compost Berm shall be constructed in accordance with the detail in the Standard Plans. Compost shall be Coarse Compost in accordance with Section 9-14.4(8).

8-01.3(9)C Straw Bale Barrier

Straw shall conform to Section 9-14.4(1).

8-01.3(9)D Inlet Protection

Inlet protection can be performed below and above the inlet grate, or as a prefabricated cover. All devices shall be installed prior to clearing, grubbing or earthwork activities and shall be as shown in the Plans.

Geotextile fabric in all prefabricated inlet protection devices shall meet or exceed the requirements of Table 1 for Moderate Survivability, and the minimum filtration properties of Table 2, in Section 9-33.2.

When the depth of accumulated sediment and debris reaches approximately ½ the height of an internal device or ⅓ the height of the external device (or less when so specified by the manufacturers), the deposits shall be removed and stabilized on site in accordance with Section 8-01.3(16).

Below Inlet Grate

Below Inlet Grate devices shall be prefabricated units specifically designed for inlet protection and shall remain securely attached to the drainage Structure when fully loaded with sediment and debris, or at the maximum level of sediment and debris specified by the manufacturer.

Above Inlet Grate

Above Inlet Grate devices may be silt fence, sandbags, or prefabricated units specifically designed for inlet protection.

The device shall remain securely in place around the drainage Structure under all conditions.

Inlet Grate Cover

Inlet Grate Cover devices shall be prefabricated units specifically designed for inlet protection and have the following features:

1. Be a sewn geotextile fabric unit fitted to the individual grate and completely enclosing the grate.
2. Have built-in lifting devices to allow manual access of the stormwater system.
3. Utilize an orange monofilament geotextile fabric.

Check dams or functionally equivalent devices may be used as inlet protection devices with the approval of the Engineer.

8-01.3(10) Wattles

Wattles shall be installed as soon as construction will allow or when designated by the Engineer. Trench construction and wattle installation shall begin from the base of the slope and work uphill. Excavated material shall be spread evenly along the uphill slope and compacted using hand tamping or other method approved by the Engineer. On gradually sloped or clay-type soils trenches shall be 2 to 3-inches deep. On loose soils, in high rainfall areas, or on steep slopes, trenches shall be 3 to 5-inches deep, or half the thickness of the wattle.

8-01.3(11) Vacant**8-01.3(12) Compost Sock**

The Contractor shall exercise care when installing compost sock to ensure that the method of installation minimizes disturbance of waterways and prevents sediment or pollutant discharge into streambed.

Compost socks shall be laced together end-to-end with coir rope to create a continuous length. Loose ends of the continuous length shall be buried 3 to 5 feet laterally into the bank. The upper surface of the compost sock shall be parallel to the slope. Finished grades shall be of a natural appearance with smooth transitions.

The compost sock shall be secured with wood stakes and live stakes of species as indicated in the Plans.

Wood stakes for compost socks shall be installed and driven into place centered on the top of the compost sock and spaced 3-feet on center throughout the length of the compost sock.

8-01.3(13) Temporary Curb

Temporary curbs may consist of asphalt, concrete, sand bags, compost socks, wattles, or geotextile/plastic encased berms of sand or gravel, or as approved by the Engineer.

Temporary curbs shall be installed along pavement edges to prevent runoff from flowing onto erodible slopes. The redirected water shall flow to a BMP designed to convey concentrated runoff. The temporary curbs shall be 4-inches in height.

8-01.3(14) Temporary Pipe Slope Drain

Pipe slope drain shall be constructed in accordance with the Plans and shall meet the requirements of Section 9-05.1(6).

Water interceptor dikes or temporary curbs shall be used to direct water into pipe slope drain. The entrance to the drain may consist of a prefabricated funnel device specifically designed for application, rock, sand bags, or as approved by the Engineer.

Pipe shall be securely fastened together and have gasketed watertight fittings, and secured to the slope with metal "T" posts, wood stakes, sand bags, or as approved by the Engineer.

The water shall be discharged to a stabilized conveyance, sediment trap, stormwater pond, rock splash pad, vegetated strip, or as approved by the Engineer.

Placement of drain shall not pond water on road surface.

8-01.3(15) Maintenance

Erosion and sediment control BMP's shall be maintained so they properly perform their function until the Engineer determines they are no longer needed.

The BMP's shall be inspected on the schedule outlined in Section 8-01.3(1)B for damage and sediment deposits. Damage to or undercutting of BMP's shall be repaired immediately.

In areas where the Contractor's activities have compromised the erosion control functions of the existing grasses, the Contractor shall oversee at no additional cost to the Contracting Agency.

Unless otherwise specified, when the depth of accumulated sediment and debris reaches approximately $\frac{1}{3}$ the height of the BMP the deposits shall be removed. Debris or contaminated sediment shall be disposed of in accordance with Section 2-03.3(7)C. Clean sediments may be stabilized on site using approved best management practices when the Engineer approves.

Erosion and sediment control BMP's that have been damaged shall be repaired or replaced immediately by the Contractor, in accordance with Section 1-07.13(4).

8-01.3(16) Removal

When the Engineer determines that an erosion control BMP is no longer required, the Contractor shall remove the BMP and all associated hardware from the project limits. When the materials are biodegradable the Engineer may approve leaving the temporary BMP in place.

The Contractor shall permanently stabilize all bare and disturbed soil after removal of erosion and sediment control BMP's. If the installation and use of the erosion control BMP's have compacted or otherwise rendered the soil inhospitable to plant growth, such as construction entrances, the Contractor shall take measures to rehabilitate the soil to facilitate plant growth. This may include, but is not limited to, ripping the soil, incorporating soil amendments, or other horticultural practices.

8-01.4 Measurement

ESC lead will be measured per day for each day that an inspection is made and a report is filed.

Compost blanket, erosion control blanket and plastic covering will be measured by the square yard along the ground slope line of surface area covered and accepted.

Check dams will be measured by the linear foot along the ground line of the completed check dam.

Stabilized construction entrance will be measured by the square yard for each entrance constructed.

Tire wash facilities will be measured per each for each wash installed.

Street cleaning will be measured by the hour for the actual time spent cleaning pavement, as authorized by the Engineer. Time to move the equipment to or from the area on which street cleaning is required will not be measured.

Inlet protection will be measured per each for each initial installation at a drainage Structure.

Silt fence, gravel filter, compost, and wood chip berms, and will be measured by the linear foot along the ground line of completed barrier.

Straw bale barrier will be measured per each for each bale placed.

Wattle and compost sock will be measured by the linear foot.

Temporary curb will be measured by the linear foot.

Temporary Pipe slope drain will be measured by the linear foot.

Seeding, fertilizing, liming, mulching, mowing, and soil binder or tacking agent will be measured by the acre by ground slope measurement or through the use of design data.

Seeding and fertilizing by hand will be measured by the square yard. No adjustment in area size will be made for the vegetation free zone around each plant.

Coir log will be measured by the linear foot along the ground line of the completed installation.

High visibility fence will be measured by the linear foot along the ground line of the completed fence.

8-01.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal

“ESC Lead”, per day.

“___ Erosion Control Blanket”, per square yard.

“Compost Blanket”, per square yard.

“Plastic Covering”, per square yard.

The unit Contract price per square yard for “Plastic Covering” shall be full pay for all equipment, labor, and materials to perform the Work as specified, including removal and disposal at an approved disposal site.

“Check Dam”, per linear foot.

“Stabilized Construction Entrance”, per square yard.

“Tire Wash”, per each.

The unit Contract price per each for tire wash shall include all costs associated with constructing, operating, maintaining, and removing the tire wash.

“Street Cleaning”, per hour.

“Inlet Protection”, per each.

“Silt Fence”, per linear foot.

“Gravel Filter Berm”, per linear foot.

“Wood Chip Berm”, per linear foot.

“Compost Berm”, per linear foot.

“Straw Bale”, per each.

“Wattle”, per linear foot.

“Compost Sock”, per linear foot.

The unit Contract price for “Compost Sock” shall include removal and disposal of the compost sock fabric if photodegradable fabric is used.

“Coir Log”, per linear foot”

“Erosion/Water Pollution Control”, by force account as provided in Section 1-09.6.

Maintenance and removal of erosion and water pollution control devices including removal and disposal of sediment, stabilization and rehabilitation of soil disturbed by these activities, and any additional Work deemed necessary by the Engineer to control erosion and water pollution will be paid by force account in accordance with Section 1-09.6.

To provide a common Proposal for all Bidders, the Contracting Agency has entered an amount in the Proposal to become a part of the Contractor’s total Bid.

“Temporary Curb”, per linear foot.

The unit Contract price per linear foot for temporary curb shall include all costs to install, maintain, remove, and dispose the temporary curb.

“Temporary Pipe Slope Drain”, per linear foot.

The unit Contract price per linear foot shall be full pay for all Work to complete and remove the installation of the pipe slope drain as shown in the Plans. All materials shall become the property of the Contractor after removal.

“Mulching”, per acre

“Mulching with PAM”, per acre

“Mulching with BFM”, per acre.

“Mulching with MBFM”, per acre.

“Temporary Seeding”, per acre.

“Seeding, Fertilizing and Mulching”, per acre.

“Seeding and Fertilizing”, per acre.

“Seeding and Fertilizing by Hand”, per square yard.

“Second Application of Fertilizer”, per acre.

“Liming”, per acre.

“Mowing”, per acre.

“Seeding and Mulching”, per acre.

“Soil Binder or Tacking Agent”, per acre.

“High Visibility Fence”, per linear foot.

The unit contract price per linear foot for “High Visibility Fence” shall be full pay for all costs to obtain, install, maintain, and remove the fence as specified. Once removed, the fencing shall remain the property of the Contractor.

8-02 ROADSIDE RESTORATION

8-02.1 Description

This Work consists of furnishing and placing topsoil, compost, and soil amendments, and furnishing and planting bare root plants, container plants, balled and burlapped plants, cuttings, fascines, live stakes, live poles, rhizomes, tubers, lawn installation, controlling weeds, performing plant establishment activities, and soil bioengineering in accordance with these Specifications and as shown in the Plans or as directed by the Engineer.

Trees, whips, shrubs, ground covers, cuttings, live stakes, live poles, rhizomes, tubers, rootstock, and seedlings will hereinafter be referred to collectively as “plants” or “plant material.”

8-02.2 Materials

Materials shall meet the requirements of the following sections:

Soil	9-14.1
Fertilizer	9-14.3
Erosion Control Blanket	9-14.5
Plant Materials	9-14.6
Stakes, Guys, and Wrapping	9-14.7
Irrigation Water	9-25.2

Botanical identification and nomenclature of plant materials shall be based on descriptions by Hitchcock and Cronquist in “Flora of the Pacific Northwest”. Botanical identification and nomenclature of plant material not found in "Flora" shall be based on Bailey in “Hortus Third” or superseding editions and amendments or as referenced in the Plans.

8-02.3 Construction Requirements

8-02.3(1) Responsibility During Construction

The Contractor shall ensure adequate and proper care of all plant material and Work done on this project until all plant establishment periods required by the Contract are complete or until Physical Completion of the project, whichever is last. Existing vegetation shall not be disturbed unless required by the Contract or approved by the Engineer.

Adequate and proper care shall include, but is not limited to, keeping all plant material in a healthy, growing condition by watering, cultivating, pruning, and spraying. Plant material crowns, runners, and branches shall be kept free of mulch at all times. This Work shall include keeping the planted areas free from insect infestation, weeds or unwanted vegetation, litter, and other debris along with retaining the finished grades and mulch in a neat uniform condition.

The Contractor shall have sole responsibility for the maintenance and appearance of the roadside restoration.

8-02.3(2) Roadside Work Plan

Before starting any Work that disturbs the earth and as described in Sections 8-01, 8-02 and 8-03, the Contractor shall submit a roadside work plan for approval by the Engineer. The roadside work plan shall define the Work necessary to provide all Contract requirements, including: clearing and grubbing, Roadway excavation and embankment, wetland excavation, soil preparation, habitat Structure placement, planting area preparation, seeding area preparation, bark mulch and compost placement, seeding, planting, plant replacement, irrigation, and weed control in narrative form.

The Roadside Work Plan shall also include the following:

Progress Schedule

In accordance with Section 1-08.3, the Progress Schedule shall include the planned time periods for Work necessary to provide all Contract requirements covered in Sections 8-01, 8-02, and 8-03. Where appropriate, notes on the schedule shall indicate the calendar dates during which these activities must occur.

Weed and Pest Control Plan

The Weed and Pest Control Plan shall be submitted and approved prior to starting any Work defined in Sections 2-03, 8-01, and 8-02.

The weed and pest control plan shall include scheduling and methods of all control measures required under the Contract or proposed by the Contractor including soil preparation methods to meet the required soil surface conditions in the planting, bark mulch, and wetland areas. The weed control plan shall show general weed control including hand, mechanical and chemical methods, timing, application of herbicides including type, rate, use and timing, mowing, and noxious weed control. Target weeds and unwanted vegetation to be removed shall be identified and listed in the weed control plan.

The plan shall be prepared and signed by a licensed Commercial Pest Control Consultant when chemical pesticides are proposed. The plan shall include methods of weed control; dates of weed control operations; and the name, application rate, and Material Safety Data sheets of all proposed herbicides. In addition, the Contractor shall furnish the Engineer with a copy of the current product label for each pesticide and spray adjuvant to be used. These product labels shall be submitted with the weed control plan for approval.

Plant Establishment Plan

The Plant Establishment Plan shall be prepared in accordance with Section 8-02.3(13), submitted and approved prior to initial planting acceptance in accordance with Section 8-02.3(12). The Plan shall show the proposed scheduling of activities, materials, equipment to be utilized for the first-year plant establishment, and an emergency contact person. The Plan shall include the management of the irrigation system, when applicable. Should the plan become unworkable at any time during the first-year plant establishment, the Contractor shall submit a revised plan prior to proceeding with further Work.

Before starting any Work described in Sections 8-02 and 8-03, the Contractor shall submit a roadside work plan for approval by the Engineer. The roadside work plan shall define the Work necessary to provide all Contract requirements, including: planting area preparation, seeding, planting, plant replacement, irrigation, and weed control in narrative form.

8-02.3(2)A Chemical Pesticides

Application of chemical pesticides shall be in accordance with the label recommendations, the Washington State Department of Ecology, local sensitive area ordinances, and Washington State Department of Agriculture laws and regulations. Only those herbicides listed in the table *Herbicides Approved for Use on WSDOT Rights of Way* (http://www.wsdot.wa.gov/maintenance/pdf/Herbicide_List.pdf) may be used. The applicator shall be licensed by the State of Washington as a Commercial Applicator or Commercial Operator with additional endorsements as required by the Special Provisions or the proposed weed control plan. The Contractor shall furnish the Engineer evidence that all operators are licensed with appropriate endorsements, and that the pesticide used is registered for use by the Washington State Department of Agriculture. All chemicals shall be delivered to the job site in the original containers. The licensed applicator or operator shall complete a Commercial Pesticide Application Record (DOT

Form 540-509) each day the pesticide is applied, and furnish a copy to the Engineer by the following business day.

The Contractor shall use extreme care to ensure confinement of the chemicals within the areas designated. The use of spray chemical pesticides shall require the use of anti-drift and activating agents, and a spray pattern indicator unless otherwise allowed by the Engineer.

The Contractor shall assume all responsibility for rendering any area unsatisfactory for planting by reason of chemical application. Damage to adjacent areas, either on or off the Highway Right of Way, shall be repaired to the satisfaction of the Engineer or the property owner, and the cost of such repair shall be borne by the Contractor.

8-02.3(2)B Weed Control

Those weeds specified as noxious by the Washington State Department of Agriculture, the local Weed District, or the County Noxious Weed Control Board and other species identified by the Contracting Agency shall be controlled on the project in accordance with the weed control plan.

Weed control will be required for all areas within the project limits designated by the Engineer including, but not limited to, planting areas, erosion control seeding areas, bark mulch areas and bark mulch rings, preservation areas, and mitigation areas.

8-02.3(3) Planting Area Weed Control

All planting areas shall be prepared so that they are weed and debris free at the time of planting and until completion of the project. The planting areas shall include the entire ground surface, regardless of cover, all planting beds, areas around plants, and those areas shown in the Plans.

All applications of post-emergent herbicides shall be made while green and growing tissue is present. Should unwanted vegetation reach the seed stage, in violation of these Specifications, the Contractor shall physically remove and bag the seed heads. All physically removed vegetation and seed heads shall be disposed of off site at no cost to the Contracting Agency.

Weed barrier mats shall be installed as shown in the Plans. Mats shall be 3-foot square and shall be secured by a minimum of five staples per mat. Mats and staples shall be installed according to the manufacturer's recommendations.

8-02.3(4) Topsoil

Topsoil shall be evenly spread over the specified areas to the depth shown in the Plans or as otherwise ordered by the Engineer. The soil shall be cultivated to a depth of 1-foot or as specified in the Special Provisions or the Plans. After the topsoil has been spread, all large clods, hard lumps, and rocks 3-inches in diameter and larger, and litter shall be raked up, removed, and disposed of by the Contractor.

Topsoil shall not be placed when the ground or topsoil is frozen, excessively wet, or in the opinion of the Engineer, in a condition detrimental to the Work.

8-02.3(4)A Topsoil Type A

Topsoil Type A shall be as specified in the Special Provisions.

8-02.3(4)B Topsoil Type B

Topsoil Type B shall be native topsoil taken from within the project limits and shall meet the requirements of Section 9-14.1(2).

Topsoil Type B shall be taken from areas designated by the Engineer to the designated depth and stockpiled at locations that will not interfere with the construction of the project, as approved by the Engineer. Areas beyond the slope stakes shall be disturbed as little as possible in the above operations.

When topsoil Type B is specified, it shall be the Contractor's responsibility to perform the excavation operations in such a manner that sufficient material is set aside to satisfy the needs of the project.

Upon Physical Completion of the Work, topsoil Type B remaining and not required for use on the project shall be disposed of by the Contractor at no expense to the Contracting Agency in accordance with Section 2-03.3(7)C.

Should a shortage of topsoil Type B occur, and the Contractor has wasted or otherwise disposed of topsoil material, the Contractor shall furnish topsoil Type C at no expense to the Contracting Agency.

Topsoil Type B will not be considered as selected material, as defined in Section 2-03.3(10), and the conditions of said section shall not apply.

Materials taken from Roadway excavation, borrow, stripping, or other excavation items, and utilized for topsoil, will not be deducted from the pay quantities for the respective items.

8-02.3(4)C Topsoil Type C

Topsoil Type C shall be native topsoil obtained from a source provided by the Contractor outside of the Contracting Agency-owned Right of Way. Topsoil Type C shall meet the requirements of Section 8-02.3(4)B and Section 9-14.1(2).

8-02.3(5) Planting Area Preparation

The Work involved in preparing planting areas shall be conducted so the flow lines in drainage channels are maintained. Material displaced by the Contractor's operations, which interferes with drainage, shall be removed from the channel and disposed of as approved by the Engineer.

Before planting and final grading takes place, the area shall be cultivated when specified in the Plans or the Special Provisions.

The areas shall be brought to a uniform finished grade, 1-inch, or the specified depth of mulch plus 1-inch, below walks, curbs, junction and valve boxes, catch basins, and driveways, unless otherwise specified. All excess material and debris, stumps, and rocks larger than 3-inches, shall be removed and disposed of off the project site or as approved by the Engineer.

8-02.3(6) Soil Amendments

Soil amendments of the type, quality, and quantities specified shall be applied where shown in the Plans or as specified in the Special Provisions. Areas receiving soil amendments shall be bare soil or vegetation free prior to application. Compost used for soil amendments shall be Fine Compost. All soil amendments shall be installed as shown in the Plans within 30 calendar days after delivery to the project site.

8-02.3(7) Layout of Planting

The Contractor shall stake the location of all trees larger than 1-inch caliper and the perimeter of all planting areas for approval by the Engineer prior to any installation activities.

The Engineer will make only the field measurements necessary to calculate and verify quantities for payment.

All trees to be planted in mowable grass areas shall be located a minimum of 10-feet from the edge of planting beds, other trees, fence lines, and bottom of ditches unless otherwise specified.

Tree locations shown in the Plans shall be considered approximate unless shown with stationing and offset distance. In irrigated areas, trees shall be located so their trunk is a minimum of $\frac{1}{2}$ of the spray radius away from the nearest sprinkler head.

Unless otherwise shown, planting beds located adjacent to Roadways shall begin at the Shoulder Subgrade.

8-02.3(8) Planting

No plant material shall be planted until it has been inspected and approved for planting by the Engineer. Rejected material shall be removed from the project site immediately. All plants for the project or a sufficient quantity to plant 1-acre of the site, whichever is less, shall be received on site prior to the Engineer beginning inspection of the plants.

Under no circumstances will planting during freezing weather or in frozen ground be permitted during unsuitable soil or weather conditions as determined by the Engineer. Unsuitable conditions may include, frozen soil, saturated soil, standing water, high winds, heavy rains, and high water levels. All planting shall be accomplished during the following periods:

1. Non-irrigated Plant Material
October 1 to March 1.
2. Irrigated Plant Material

In irrigated areas, plant material shall not be installed until the irrigation system is fully operational. Trees and shrubs may be planted in irrigated areas during the non-irrigated planting window before the irrigation system is functional with the written approval of the Engineer only if the irrigation system is guaranteed to be operational prior to the end of the non-irrigated planting window.

Plants shall not be placed in areas that are below the finished grade.

Planting hole sizes for plant material shall be in accordance with the details shown in the Plans. Any glazed surface of the planting hole shall be removed by hand methods.

Plant material supplied in containers shall not be removed from the containers until the time of planting at the planting location. Roots of bare root stock shall not be bunched, curled, twisted, or unreasonably bent when placed in the planting hole. Root balls shall be loosened prior to planting. All bare root plant material shall be dormant at the time of planting.

All burlap, baskets, string, wire and other such materials shall be removed from the hole when planting balled and burlapped plants. The plant material shall be handled in such a manner that the root systems are kept covered and damp at all times. The root systems of all bare root plant material shall be dipped in a slurry as specified in the Special Provisions immediately prior to planting. The root systems of container plant material shall be moist at the time of planting. In their final position, all plants shall have their top true root (not adventitious root) no more than 1-inch below the soil surface, no matter where that root was located in the original root ball or container. The backfill material and root ball shall be thoroughly watered on the same day that planting occurs regardless of season.

8-02.3(9) Pruning, Staking, Guying, and Wrapping

Plants shall be pruned at the time of planting, only to remove minor broken or damaged twigs, branches or roots. Pruning shall be done with a sharp tool and shall be done in such a manner as to retain or to encourage natural growth characteristics of the plants. All other pruning shall be performed only after the plants have been in the ground at least 1-year.

Trees shall only be staked when so noted in the Plans. Each tree shall be staked or guyed before completion of the backfilling in accordance with the details shown in the Plans.

All staking and guying shall be completely removed at the end of the first year of plant establishment, unless otherwise approved by the Engineer.

8-02.3(10) Fertilizers

Fertilizers shall be applied in the form specified in the Special Provisions. Application procedures shall be in accordance with the manufacturer's recommendations or as specified in the Special Provisions. The Contractor shall submit for approval a guaranteed fertilizer analysis label for the selected product.

8-02.3(11) Bark or Wood Chip Mulch

Bark or wood chip mulch of the type and depth specified shall be applied where shown in the Plans or as specified in the Special Provisions. Any contamination of the mulch due to the Contractor's operations shall be corrected to its former condition at the Contractor's expense. Mulch shall be feathered to the base of the plant and 1-inch below the top of junction and valve boxes, curbs, and pavement edges. All plant crowns shall be free of mulch. Mulch placed to a thickness greater than specified shall be at no additional cost to the Contracting Agency.

Areas receiving bark mulch shall be bare soil or vegetation free before application.

8-02.3(12) Completion of Initial Planting

Upon completion of the initial planting within a designated area, the Engineer will make an inspection of all plant material and notify the Contractor, in writing, of any replacements or corrective action necessary to meet the Contract Provisions. The Contractor shall replace all materials rejected or missing and correct unsatisfactory conditions.

Completion of the initial planting within a designated area includes the following:

1. 100-percent of each of the plant material categories shall be installed as shown in the Contract Plans.
2. Planting Area cleanup.
3. Repairs completed for the entire project, including but not limited to full operation of the irrigation system, complete mulch coverage, and all weeds controlled.
4. Approval of plant establishment plan.

8-02.3(13) Plant Establishment

Plant establishment shall consist of caring for all plants planted on the project and caring for the planting areas within the project limits. The provisions of Section 1-07.13(2) and 1-07.13(3) do not apply to this section.

The Contractor shall submit a first-year plant establishment plan, for approval by the Engineer. The first year of plant establishment shall begin immediately upon written notification from the Engineer of the completion of initial planting for the project. The first-year plant establishment period shall be a minimum of 1-calendar year.

During the first-year plant establishment period, it shall be the Contractor's responsibility to perform all Work necessary to ensure the resumption and continued growth of the transplanted material. This care shall include, but not be limited to, labor and materials necessary for removal of foreign, dead, or rejected plant material, maintaining a weed-free condition, and the replacement of all unsatisfactory plant material planted under the Contract. If plants are stolen or damaged by the acts of others, the Contracting Agency will pay invoice cost only for the replacement plants with no mark-up and the Contractor will be responsible for the labor to install the replacement plants.

During the first year of plant establishment under PSIPE, the Contractor shall meet monthly with the Engineer for the purpose of joint inspection of the planting material on a mutually agreed upon schedule. The Contractor shall correct all conditions unsatisfactory to the Engineer within a 10-day period immediately following the inspection. If plant replacement is required, the Contractor shall, within the 10-day period, propose a plan and schedule for the plant replacement to occur immediately at the beginning of the planting period as designated in Section 8-02.3(8). Failure to comply with corrective steps as outlined by the Engineer shall constitute justification for the Contracting Agency to take corrective steps and to deduct all costs thereof from any monies due the Contractor. At the end of the plant establishment period, plants that do not show normal growth shall be replaced.

All automatic irrigation systems shall be operated fully automatic during the plant establishment period and until final acceptance of the Contract. Payment for water used to water in plants, or hand watering of plant material or lawn areas unless otherwise specified, is the responsibility of the Contractor during the first-year plant establishment period.

Subsequent year plant establishment periods, when included in the Contract, shall begin immediately at the completion of the preceding year's plant establishment period. Each subsequent year plant establishment period shall be 1 full calendar year in duration.

During the plant establishment period(s) after PSIPE, the Contractor shall perform all Work necessary for the continued healthy and vigorous growth of all plant material as directed by the Engineer.

8-02.3(14) Plant Replacement

The Contractor shall be responsible for growing or providing enough plants for replacement of all plant material rejected through first-year plant establishment. All replacement plant material shall be inspected and approved by the Engineer prior to installation. All rejected plant material shall be replaced at dates approved by the Engineer.

All replacement plants shall be of the same species and quality as the plants they replace. Plants may vary in size reflecting 1 season of growth should the Contractor elect to hold plant material under nursery conditions for an additional year to serve as replacement plants. Replacement plant material larger than specified in the Plans shall meet the applicable section requirements of the ASNS for container class, ball size, spread, and branching characteristics.

8-02.3(15) Live Fascines

Live fascines are constructed of live and dead cuttings bundled together with a minimum diameter of 8-inches. Live cuttings shall be as shown in the Plans. Dead branches may be cuttings from any woody, non-invasive plant, native to the project area. Dead branches may be placed on the inside of the live fascine and on the side exposed to the surface. Live branches shall be placed in contact with the soil along their entire length. Each live fascine must contain a minimum of 8 live branches. Dead branches shall constitute no more than 40-percent of the total fascine content.

The total length of each live fascine shall be a minimum of 5-feet. Branches shall be bound with biodegradable twine spaced at 1-foot intervals along the entire length of the live fascine. Twine shall meet the requirements of Section 9-33.1 Table 3. Live fascines shall be installed in a trench whose depth shall be $\frac{1}{2}$ the diameter of the live fascine. Secure the live fascine with live stakes 3-feet in length and $\frac{3}{4}$ -inch in diameter placed at 18-inch intervals. A minimum of 3 live stakes shall be used per fascine. Live stakes shall be driven through the live fascine vertically into the slope. The ends of live fascines shall be woven together so that no gap remains between the 2 sections of the live fascine.

8-02.3(16) Lawn Installation**8-02.3(16)A Lawn Installation**

In irrigated areas, lawn installation shall not begin until the irrigation system is fully operational.

Seed mix and rate of application shall be as specified in the Special Provisions.

Unless otherwise approved by the Engineer, seeded lawn installation shall be performed during the following time periods at the location shown:

West of the summit of the Cascade Range - March 1 to October 1.

East of the summit of the Cascade Range - April 15 to October 1.

The Contractor shall have the option of sodding in lieu of seeding for lawn installation at no additional expense to the Contracting Agency. Seeding in lieu of sodding will not be allowed.

Topsoil for seeded or sodded lawns shall be placed at the depth and locations shown in the Plans. The topsoil shall be cultivated to the specified depth, raked to a smooth even grade without low areas to trap water and compacted, all as approved by the Engineer.

Sod strips shall be placed within 48-hours of being cut. Placement shall be without voids and have the end joints staggered. The sod shall be rolled with a smooth roller following placement.

Barriers shall be erected, with warning signs where necessary, to preclude pedestrian traffic access to the newly placed lawn during the establishment period.

8-02.3(16)B Lawn Establishment

Lawn establishment shall consist of caring for all new lawn areas within the limits of the project.

The lawn establishment period shall begin immediately after the lawn planting has been accepted by the Engineer and shall extend to the end of 4 mowings or 20-working days which ever is longer. The mowings shall be done in accordance with 8-02.3(16)C.

During the lawn establishment period, it shall be the Contractor's responsibility to ensure the continuing healthy growth of the turf. This care shall include labor and materials necessary to keep the project in a presentable condition, including but not limited to, removal of litter, mowing, trimming, removal of grass clippings, edging, fertilization, insecticide and fungicide applications, weed control, watering, repairing the irrigation system, and repair and reseeded any and all damaged areas. Lawn mowing shall be performed once each week, or as ordered by the Engineer, during the lawn establishment period with no additional compensation.

Temporary barriers shall be removed only on written permission from the Engineer.

All Work performed under lawn establishment shall comply with established turf management practices.

Acceptance of lawn planting as specified shall be based on a uniform stand of grass and a uniform grade at the time of final inspection. Areas that are bare or have a poor stand of grass, and areas not having a uniform grade through any cause before final inspection, shall be recultivated, regraded, reseeded, or resodded and refertilized as specified at no additional cost to the Contracting Agency.

8-02.3(16)C Lawn Mowing

Lawn mowing shall begin immediately after the lawn establishment period has been accepted by the Engineer and shall extend to the end of the Contract or the first-year plant establishment, whichever is last.

The Contractor shall accomplish the following minimum requirements:

1. Mowing, trimming, and edging shall be done as often as conditions dictate. Maximum height of lawn shall not exceed 3-inches. The cutting height shall be 2-inches. Cuttings, trimmings, and edgings shall be disposed of off the project site. When the Engineer approves the use of a mulching mower, trimmings may be left in place.
2. Watering shall be as often as conditions dictate depending on weather and soil conditions.
3. Provide fertilizer, weed control, and other measures as necessary to maintain a healthy stand of grass.

8-02.4 Measurement

Topsoil, mulch and soil amendments will be measured by the cubic yard in the haul conveyance at the point of delivery.

Brush layer will be measured by the linear foot along the ground slope line.

Live pole will be measured per each.

Live stake row will be measured by the linear foot along the ground slope line.

Fascine will be measured by the linear foot along the ground slope line.

Live brush mattress will be measured by the surface square yard along the ground slope line.

Compost will be measured by the cubic yard in the haul conveyance at the point of delivery.

The quantity of topsoil Type B used on the project will not be deducted from the total quantity of Roadway excavation, borrow, strippings, or other excavation for which haul is being paid.

The pay quantities for plant materials will be determined by count of the number of satisfactory plants in each category accepted by the Engineer.

Weed barrier mat will be measured per each.

Fertilizer will be measured in pounds.

Water will be measured in accordance with Section 2-07.4. Measurement will be made of only that water hauled in tank trucks or similar equipment.

Seeded lawn, sod installations, and lawn mowing will be measured along the ground slope and computed in square yards of actual lawn completed, established, and accepted.

8-02.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following listed Bid items that are included in the Proposal:

“Topsoil Type ____”, per cubic yard.

The unit contract price per cubic yard for “Topsoil Type ____” shall be full pay for providing the source of material for topsoil Type A and C, for pre-excavation weed control, excavating, loading, hauling, intermediate windrowing, stockpiling, weed control on stockpiles or windrows, and removal, placing, spreading, processing, cultivating, and compacting topsoil Type A, Type B, and Type C.

“Plant Selection ____”, per each.

“PSIPE ____”, per each. (PSIPE is Plant Selection Including Plant Establishment.)

The unit Contract price for “Plant Selection ____”, per each, and “PSIPE ____”, per each, shall be full pay for all materials, labor, tools, equipment, and supplies necessary for weed control within the planting area, planting area preparation, fine grading, planting, cultivating, plant storage and protection, fertilizer and root dip, staking, cleanup, and water necessary to complete planting operations as specified.

As the plants that include plant establishment are obtained, propagated, and grown, partial payments shall be made as follows after inspection by the Engineer:

Payment of 5-percent of the unit Contract price, per each, when the plant materials have been contracted, propagated, and are growing under nursery conditions. The Contractor shall provide the Engineer with certification that the plant material has been procured or contracted for delivery to the project for planting within the time limits of the project. The certification shall state the location, quantity, and size of all material.

Payment shall be increased to 15-percent of the unit Contract price, per each, upon completion of the initial weed control Work.

Payment shall be increased to 60-percent of the unit Contract price per each for the contracted plant material in a designated unit area when planted.

Payment shall be increased to 70-percent of the unit Contract price per each for contracted plant material at the completion of the initial planting.

Payment shall be increased to the appropriate percentage upon reaching the following plant establishment milestones:

June 30 th	80-percent
September 30 th	90-percent
Completion of 1st-year plant establishment or after all replacement plants have been installed, whichever is later	100-percent

As the plants that do not include plant establishment are obtained, propagated, and grown, partial payments shall be made as follows:

Payment of 15-percent of the unit Contract price per each when the plant materials have been contracted, propagated, and are growing under nursery conditions. The Contractor shall provide the Engineer with certification that the plant material has been procured or contracted for delivery to the project for planting within the time limits of the project. The certification shall state the location, quantity, and size of all material.

Payment shall be increased to 90-percent of the unit Contract price per each for contracted plant material at the completion of the initial planting.

Payment shall be increased to 100-percent at the Physical Completion of the Contract.

All partial payments shall be limited to the actual number of healthy vigorous plants that meet the stage requirements, limited to plan quantity. Previous partial payments made for materials rejected or missing will be deducted from future payments due the Contractor.

“Live Pole”, per each.

“Live Stake Row”, per linear foot.

“Live Brush Mattress”, per square yard.

“Plant Establishment - ____ Year”, will be paid in accordance with Section 1-09.6.

“Brush Layer”, per linear foot.

“Fascines”, per linear foot.

“Weed Barrier Mat”, per each.

The unit Contract price per each for “Weed Barrier Mat” shall be full pay to provide and install the weed barrier mat as specified, to maintain the mat in place throughout the plant establishment period, and to remove the mat when ordered by the Engineer.

“Fine Compost”, per cubic yard.

“Coarse Compost”, per cubic yard.

The unit Contract price per cubic yard for “Fine Compost” or “Coarse Compost” shall be full pay for furnishing and spreading the compost onto the existing soil.

“Fertilizer”, per pound.

The unit Contract price per pound for “Fertilizer” shall be full pay for furnishing and applying the fertilizer.

“Weed Control”, when included as a separate Bid item, will be paid in accordance with Section 1-09.6.

“Pesticide Application”, will be paid in accordance with Section 1-09.6.

For the purpose of providing a common Proposal for all Bidders, the Contracting Agency entered an amount for “Plant Establishment - ____ Year”, “Weed Control”, and “Pesticide Application” in the Proposal to become a part of the total Bid by the Contractor.

“Soil Amendment”, per cubic yard.

“Bark or Wood Chip Mulch”, per cubic yard.

“Water”, per M Gal.

“Seeded Lawn Installation”, per square yard.

“Sod Installation”, per square yard.

“Lawn Mowing”, per square yard.

The unit Contract price per square yard for “Seeded Lawn Installation” or “Sod Installation” shall be full pay for all costs necessary for weed control within the seeding or sodding area, to prepare the area, plant or sod the lawn, erect barriers, and establish lawn areas and for furnishing all labor, tools, equipment, and materials necessary to complete the Work as specified and shall be paid in the following sequence for healthy, vigorous lawn:

Completion of Lawn Planting	60-percent of individual areas
Mid Lawn Establishment (after 2 mowings)	85-percent of individual areas
Completion of Lawn Establishment (after 4 mowings)	100-percent of individual areas

8-03 IRRIGATION SYSTEMS

8-03.1 Description

This Work consists of installing an irrigation system in accordance with these Specifications and the details shown in the Plans or as staked.

8-03.2 Materials

Materials shall meet the requirements of Sections 9-15 and 9-29.

8-03.3 Construction Requirements

Location of pipe, tubing, sprinkler heads, emitters, valves, and other equipment shall be as shown in the Plans and shall be of the size and type indicated. No changes shall be made except as approved by the Engineer.

Potable water supplies shall be protected against cross connections in accordance with applicable Contracting Agency and Washington State Department of Health rules and regulations. Irrigation systems using a non-potable water source shall have equipment marked with appropriate purple markers as supplied by the equipment manufacturer.

Construction of electrical systems shall conform to applicable portions of Sections 8-20 and 9-29.

8-03.3(1) Layout of Irrigation System

The Contractor shall stake the irrigation system following the schematic design shown in the Plans, before the construction begins for approval by the Engineer. Alterations and changes in the layout may be expected in order to conform to ground conditions and to obtain full and adequate coverage of plant material with water; however, no changes in the system as planned shall be made without the prior authorization of the Engineer.

Irrigation Potholing

Existing underground irrigation sleeve ends shall be located by potholing.

8-03.3(2) Excavation

Pipe trenches shall be no wider at any point than is necessary to lay the pipe or install equipment. The top 6-inches of topsoil, when such exists, shall be kept separate from subsoil and shall be replaced as the top layer when backfill is made. Trench bottoms shall be relatively smooth and consist of sand or other suitable material free from rocks, stones, or any material that might damage the pipe. Trenches in rock or other material unsuitable for trench bottoms shall be excavated 6-inches below the required depth and shall be backfilled to the required depth with sand or other suitable material free from rocks or stones.

The Contractor shall exercise care when excavating trenches near existing trees to minimize damage to tree roots. Where roots are 2-inches and greater in diameter, except in the direct path of the pipe, the pipe trench shall be hand excavated and tunneled. When large roots are exposed, they shall be wrapped with heavy burlap for protection and to prevent excessive drying. Trenches dug by machines adjacent to trees having roots 2-inches and less in diameter shall have the sides hand trimmed making a clean cut of the roots. Trenches having exposed tree roots shall be backfilled within 24-hours unless adequately protected by moist burlap or canvas as approved by the Engineer.

Detectable marking tape shall be placed in the trench 6-inches directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum sleeves, conduits and casing pipe. The width of the tape shall be as recommended by the manufacturer for the depth of installation.

8-03.3(3) Piping

All lines shall be a minimum of 18-inches below finished grade measured from the bottom of the pipe or as shown in the Plans. All live mains to be constructed under existing pavement shall be placed in steel casing jacked under pavement as shown in the Plans. All PVC pipe installed under areas to be paved shall be placed in irrigation conduit. Irrigation conduit shall extend a minimum of 1-foot beyond the limits of pavement. All jacking operations shall be performed in accordance with an approved jacking plan. Where possible, mains and laterals or section piping shall be placed in the same trench. All lines shall be placed a minimum of 3-feet from the edge of concrete sidewalks, curbs, guardrail, walls, fences, or traffic barriers.

Mainlines and lateral lines shall be defined as follows:

Mainlines: All supply pipe and fittings between the water meter and the irrigation control valves.

Lateral Lines: All supply pipe and fittings between the irrigation control valves and the connections to the irrigation heads. Swing joints, thick walled poly pipe, flexible risers, rigid pipe risers, and associated fittings are not considered part of the lateral line but incidental components of the irrigation heads.

Pipe pulling will not be allowed for installation and placement of irrigation pipe.

8-03.3(4) Jointing

During construction, pipe ends shall be plugged or capped to prevent entry of dirt, rocks, or other debris.

All galvanized steel pipe shall have sound, clean cut, standard pipe threads well fitted. All pipes shall be reamed to the full diameter and burrs removed before assembly. Threaded galvanized steel joints shall be constructed using either a nonhardening, nonseizing multipurpose sealant or Teflon tape or paste as recommended by the pipe manufacturer. All threaded joints shall be made tight with wrenches without the use of handle extensions. Joints that leak shall be cleaned and remade with new material. Caulking or thread cement to make joints tight will not be permitted.

PVC pipe, couplings, and fittings shall be handled and installed in accordance with the manufacturer's recommendation. The outside of the PVC pipe shall be chamfered to a minimum of 1/16-inch at approximately 22-degrees. Pipe and fittings shall be joined by solvent welding. Solvents used must penetrate the surface of both pipe and fitting which will result in complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer.

Threaded PVC joints shall be assembled using Teflon tape as recommended by the pipe manufacturer.

On plastic to metal connections, work the metal connection first. Use a nonhardening compound on threaded connections. Connections between metal and plastic are to be threaded utilizing female threaded PVC adapters with threaded schedule 80-PVC nipple only.

Polyethylene pipe and fittings shall be installed in accordance with the manufacturer's recommendations. The ends of the polyethylene pipe shall be cut square and inserted to the full depth of the fitting. Clamps for insert fittings shall be stainless steel.

8-03.3(5) Installation

Galvanized pipe shall be used from the water meter or service connection through the cross connection control device.

Final position of turf heads shall be between ½-inch and 1-inch above finished grade measured from the top of the sprinkler. All sprinklers adjacent to walks, curbs, and pavement shall be placed as shown in the Plans.

Shrub heads, unless otherwise specified, shall be placed on risers approximately 12-inches above finished grade.

Final position of valve boxes, capped sleeves, and quick coupler valves shall be between ½-inch and 1-inch above finished grade or mulch.

Drip irrigation emitters shall be installed in accordance with the manufacturer's recommendations. Install drain valves at the lowest point of each zone in an 8-inch diameter round valve box over 3 cubic feet of washed gravel.

8-03.3(6) Electrical Wire Installation

Wiring between the automatic controller and automatic valves shall be direct burial and may share a common neutral. Separate control conductors shall be run from the automatic controller to each valve. When more than 1 automatic controller is required, a separate common neutral shall be provided for each controller and the automatic valve which it controls. Wire shall be installed adjacent to or beneath the irrigation pipe. Plastic tape or nylon tie wraps shall be used to bundle wires together at 10-foot intervals, and the wire shall be "snaked" from side to side in the trench. When necessary to run wire separate from the irrigation pipe, the wire shall be bundled and placed under detectable marking tape. When lateral pipelines have less than 18-inches of cover, direct burial wire shall not be adjacent to pipes but shall be placed at a minimum depth of 18-inches.

Wiring placed under pavement and walls, or through walls, shall be placed in irrigation casing. Irrigation casing shall not be less than 1-inch in diameter, Class 200-PVC.

Splices will be permitted only at junction boxes, valve boxes, pole bases, or at control equipment. A minimum of 2-feet of excess conductor shall be left at all splices, terminal and control valves to facilitate inspection and future splicing.

All 120-volt electrical conductors and conduit shall be installed by a certified electrician including all wire splices and wire terminations.

For all 24-volt direct burial circuits, the continuity test, ground test, and functional test shall be performed. The Megger test confirming insulation resistance of not less than 2 megohms to ground in accordance with Section 8-20.3(11) is required.

All wiring shall be tested in accordance with Section 8-20.3(11).

8-03.3(7) Flushing and Testing

All gauges used in the testing of water pressures shall be certified correct by an independent testing laboratory immediately prior to use on the project. Gauges shall be retested when ordered by the Engineer.

Automatic controllers shall be tested by actual operation for a period of 2-weeks under normal operating conditions. Should adjustments be required, the Contractor shall do so according to the manufacturer's direction and test until operation is satisfactory.

Main Line Flushing

All main supply lines shall receive 2 fully open flushings, to remove debris that may have entered the line during construction: the first before placement of valves; the second after placement of valves and prior to testing.

Main Line Testing

All main supply lines shall be purged of air and tested with a minimum static water pressure of 150-psi for 60-minutes without introduction of additional service or pumping pressure. Testing shall be done with 1 pressure gauge installed on the line, where ordered by the Engineer. An additional pressure gauge shall be installed at the pump when ordered by the Engineer. Lines that show loss of pressure exceeding 5-psi at the ends of specified test periods will be rejected.

The Contractor shall correct rejected installations and retest for leaks as specified herein.

Lateral Line Flushing

All lateral lines shall receive 1 fully open flushing prior to placement of sprinkler heads, emitters, and drain valves. The flushing shall be of sufficient duration to remove any dirt or debris that has entered the lateral lines during construction.

Lateral Line Testing

All lateral lines shall be purged of air and tested in place at operating line pressure with a pressure gauge and with all fittings capped or plugged. The operating line pressure shall be maintained for 30-minutes with valves closed and without introduction of additional pressure. Lines that show leaks or loss of pressure exceeding 5-psi at the end of specified test periods will be rejected.

The Contractor shall correct and retest lateral line installations that have been rejected. Throughout the life of the Contract, the Contractor shall repair, flush, and test, all main and lateral lines that have sustained a break or disruption of service. Upon restoration of the water service, the affected lines shall be brought up to operating pressure. The Contractor shall then conduct a thorough inspection of all sprinkler heads, emitters, etc., located downstream of the break, disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

8-03.3(8) Adjusting System

Before final inspection, the Contractor shall adjust and balance all sprinklers to provide adequate and uniform coverage. Spray patterns shall be balanced by adjusting individual sprinkler heads with the adjustment screws or replacing nozzles to produce a uniform pattern. Unless otherwise specified, sprinkler spray patterns will not be permitted on pavement, walks, or Structures.

8-03.3(9) Backfill

Backfill shall not be started until all piping has been inspected, tested, and approved by the Engineer, after which backfilling shall be completed as soon as possible. All backfill material placed within 6-inches of the pipe shall be sand or other suitable material free of rocks, roots, or other objectionable material that might cut or otherwise damage the pipe. Backfill from the bottom of the trench to approximately 6-inches above the pipe shall be by continuous compacting in a manner that will not damage pipe or wiring and shall proceed evenly on both sides of the pipe. The remainder of the backfill shall be thoroughly compacted, except that heavy equipment shall not be used within 18-inches of any pipe. The top 6-inches of the backfill shall be of topsoil material or the first 6-inches of material removed in the excavation.

8-03.3(10) As Built Plans

Upon Physical Completion of the Work, the Contractor shall submit As Built Plans consisting of corrected shop drawings, schematic circuit diagrams, or other details necessary to show the Work as constructed including the actual installed locations of the irrigation system(s) equipment including, but not limited to, water meters, cross connection control devices, electrical services, pipe and wire runs, splice boxes,

controllers, valves, heads, and other equipment. These drawings shall be on sheets conforming in size to the provisions of Section 1-05.3. All drawings must be complete and legible.

Any corrections and additions ordered by the Engineer shall be made by the Contractor prior to acceptance. The Contractor shall provide the Engineer with 3 copies of parts lists, catalog cuts, and service manuals for all equipment installed on the project.

8-03.3(11) System Operation

The irrigation system shall be completely installed, tested, and automatically operable prior to planting in a unit area except where otherwise specified in the Plans or approved by the Engineer. The Contractor shall be fully responsible for all maintenance, repair, testing, inspecting, and automatic operation of the entire system until all Work is considered complete as determined by the final inspection specified in Section 1-05.11. The final inspection of the irrigation system will coincide with the end of the Contract or first-year plant establishment which ever is later.

This responsibility shall include, but not be limited to, draining the system prior to winter and reactivating the system in the spring and at other times as ordered by the Engineer.

For the life of the Contract, the Contractor shall be responsible for having annual inspections and tests performed on all cross connection control devices as required and specified by the Washington State Department of Health. Inspections and tests shall be conducted at the time of initial activation and each spring prior to reactivating the irrigation system. Potable water shall not flow through the cross-connection control device to any downstream component until tested and approved for use by the serving utility.

In the spring, when the drip irrigation system is in full operation, the Contractor shall make a full inspection of all emitters. This shall involve visual inspection of each emitter under operating conditions. All adjustments, flushings, or replacements to the system shall be made at this time to ensure the proper operation of all emitters.

8-03.3(12) Cross Connection Control Device Installation

Cross connection control devices shall be installed, inspected, and tested by the serving utility or designee in accordance with applicable portions of the Washington Administrative Code (WAC-246-290-490) and other applicable regulations as set forth by the Washington State Department of Health and the Washington State Department of Transportation.

During the life of the Contract, these devices shall be inspected and tested annually, or more often if successive inspections indicate repeated failures. Inspections and tests shall be conducted at the time of initial installation, after repairs, and each spring prior to reactivation of the irrigation system. These inspections and tests shall be completed and the results recorded by a licensed Backflow Assembly Device Tester (BADT) Operator or by a Contracting Agency Certified Water Works Operator with a CCS 1 or CCS 2 Classification and shall document that the devices are in good operating condition prior to flushing and testing of any downstream water lines. Devices that are defective shall be repaired or replaced.

Inspection and test results shall be recorded on Department of Transportation Form No. DOT 540-020 and other forms as may be required by the serving utility. The completed forms shall be submitted to the appropriate health authority and to the serving utility when applicable.

8-03.3(13) Irrigation Water Service

The Contracting Agency has arranged for a water meter installation(s) for the irrigation system at no cost to the Contractor at the locations and sizes as shown in the Plans. The water meter(s) will be installed by the serving utility. It shall be the Contractor's responsibility to contact the Engineer to schedule the water meter installation performed by the servicing utility. The Contractor shall provide a minimum of 60-calendar days prior notice to the Engineer for the desired date for installation to ensure no service installation delays Work.

Construction activities for irrigation water service connections will be in accordance with the serving utility's Service Agreement. A copy of the Service Agreement may be obtained from the Engineer.

8-03.3(14) Irrigation Electrical Service

The Contracting Agency has arranged for electrical service connection(s) for operation of the automatic electrical controller(s) at the locations as shown in the Plans. The Contractor shall splice and run conduit and wire from the electrical service connection(s), or service cabinet, which ever may apply, to the automatic electrical controller and connect the conductors to the circuit(s) as shown in the Plans.

The installation of conduit and wire for the electrical power service shall be in accordance with the serving utility's Service Agreement and these Specifications. A copy of the Service Agreement may be obtained from the Engineer.

8-03.4 Measurement

No unit of measure shall apply to the lump sum price for irrigation system.

8-03.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid items when included in the Proposal:

"Irrigation System", lump sum.

All costs for furnishing and installing irrigation system equipment and components where indicated and as detailed in the Plans, all costs of initial and annual inspections and tests performed on cross connection control devices and electrical wire testing during the life of the Contract and As Built Plans shall be included in the lump sum price for the complete irrigation system as shown in the Plans or as otherwise approved by the Engineer.

The Contracting Agency will, at no cost to the Contractor, provide water and electrical services needed for installation and operation of the irrigation system for the life of the Contract.

As the irrigation system is installed, the payment schedule will be as follows:

Payment will be made in proportion to the amount of Work performed up to 90-percent of the unit Contract price for irrigation system when the irrigation system is completed, tested, inspected, and fully operational.

Payment shall be increased to 95-percent of the unit Contract price for irrigation system upon completion and acceptance of initial planting and submittal of As Built Plans.

Payment shall be increased to 100-percent of the unit Contract price for irrigation system upon completion and acceptance of the first-year plant establishment. When there is no first-year plant establishment or when the Contract is completed, payment will be increased to 100-percent of the unit Contract price for irrigation system upon completion of As Built Plans.

8-04 CURBS, GUTTERS, AND SPILLWAYS

8-04.1 Description

This Work consists of the construction of cement concrete curbs, curbs and gutters, gutters, spillways, hot mix asphalt curbs, gutters, spillways, and metal spillways, of the kind and design specified, at the locations shown in the Plans or where designated by the Engineer in accordance with these Specifications and in conformity to the lines and grades as staked.

8-04.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregates	9-03
Premolded Joint Filler	9-04.1
Drain Pipe	9-05.1
Steel Culvert Pipe and Pipe Arch	9-05.4
Aluminum Culvert Pipe	9-05.5
Structural Steel and Related Materials	9-06
Reinforcing Steel	9-07
Hand Placed Riprap	9-13.2

Hot Mix Asphalt (HMA) curbs, gutters, and spillways shall be constructed of an HMA mix that will have a dense, uniform surface and will fully retain its shape, grade, and line after placement. The mix components shall meet applicable requirements for asphalt concrete specified in Section 5-04 and shall be approved by the Engineer.

8-04.3 Construction Requirements

8-04.3(1) Cement Concrete Curbs, Gutters, and Spillways

Cement concrete curb, curb and gutter, gutter, and spillway shall be constructed with air entrained concrete Class 3000 conforming to the requirement of Section 6-02 except at driveway entrances. Cement concrete curb or curb and gutter along the full width of a driveway entrance shall be constructed with air entrained concrete Class 4000 conforming to the requirements of Section 6-02.

The foundation for curbs, gutters, and spillways shall be thoroughly compacted and required side forms shall rest throughout their length on firm ground. Side forms for straight sections shall be full depth of the curb. They shall be either metal of suitable gage for the Work or surfaced "construction" grade lumber not less than 2-inches (commercial) in thickness. Forms used more than 1 time shall be thoroughly cleaned and any forms that have become worn, splintered, or warped shall not be used again.

The foundation shall be watered thoroughly before the concrete is placed, and the concrete shall be well tamped and spaded or vibrated in the forms. The exposed surfaces shall be finished full width with a trowel and edger. Within 24-hours after the concrete is placed, the forms of the Roadway face of curbs shall be removed, and the concrete treated with a float finish. The top and face of the curb shall receive a light brush finish, and the top of the gutter shall receive a broom finish.

Expansion joints in the curb or curb and gutter shall be spaced at 15-foot intervals, the beginning and ends of curb returns, drainage Structures, bridges, and cold joints with existing curbs and gutters. The expansion joint shall be filled to full cross-section with

$\frac{3}{8}$ -inch premolded joint filler. When curb or curb and gutter is placed adjacent to Portland Cement Concrete Pavement, a $\frac{1}{4}$ -inch thick, 6-inch deep premolded joint filler shall be installed between the 2 vertical surfaces to prevent cracking. When noted in the Plans, the Contractor shall install the catch basin gutter pan at drainage Structures abutting the curb and gutter.

The concrete shall be cured for 72-hours by 1 of the methods specified for cement concrete pavement in Section 5-05.

At the option of the Contractor, the curb and gutter may be constructed using approved slip-form equipment. The curb and gutter shall be constructed to the same requirements as the cast-in-place curb and gutter.

A water-reducing admixture conforming to the requirements of Section 9-26 may be used provided the finished curb and gutter shall retain its line and shape.

8-04.3(1)A Extruded Cement Concrete Curb

Extruded cement concrete curb shall be placed, shaped, and compacted true to line and grade with an approved extrusion machine. The extrusion machine shall be capable of shaping and thoroughly compacting the concrete to the required cross section.

The pavement shall be dry and cleaned of loose and deleterious material prior to curb placement. Cement concrete curbs shall be anchored to the existing pavement by placing steel tie bars 1-foot on each side of every joint.

Tie bars shall meet the dimensions shown in the Standard Plans.

Joints in the curb shall be spaced at 10-foot intervals. Joints shall be cut vertically and to the depth shown in the Standard Plans.

All other requirements for cement curb and cement concrete curb and gutter shall apply to extruded cement concrete curb.

The Contractor may substitute extruded cement concrete curb for extruded HMA concrete curb upon receiving written permission from the Engineer. There will be no change in unit Contract price if this substitution is allowed.

8-04.3(2) Extruded Asphalt Concrete Curbs, and Gutters

Asphalt concrete curbs, gutters, and spillways shall be constructed of Commercial HMA as specified in Section 5-04. The HMA will have a dense, uniform surface and will fully retain its shape, grade, and line after placement. Just prior to placing the curb, a tack coat of asphalt shall be applied to the existing pavement surface at the rate ordered by the Engineer.

Set forms will not be required for forming gutter if slip-form equipment of a type approved by the Engineer is used. Gutter shall be shaped and compacted to the required line, grade, and cross section. Connections to any type of outlet shall be constructed so as to form a watertight joint.

8-04.3(3) Vacant

8-04.3(4) Metal Spillways

Round metal spillways shall be plain metal drain pipe 8-inch diameter and when specified in the Contract, the joints shall be sealed with rubber gaskets conforming to the requirements of Section 9-04.4(4). Half round metal spillways shall be half round metal culvert pipe of the size, kind, and thickness shown in the Plans.

In the construction of metal spillways, sufficient bands, elbows, and joints shall be furnished and placed by the Contractor to permit the construction and connection of the spillways as indicated in the Plans so as to carry the drainage from gutters to the inlets and spillways without percolation of the water under and around the Structure.

Spillway pipe shall be laid in a trench in the embankment slope and shall not be placed until after the embankment slopes have been completed and dressed to the lines prescribed by the Engineer. The lower end of the pipe spillway shall be adequately protected and supported by hand placed riprap, concrete, or by other means as may be shown in the Plans. After the spillway pipe has been placed and connected, the trench shall be backfilled, thoroughly compacted, and the embankment slopes restored to their original condition.

8-04.3(5) Spillways at Bridge Ends

Where spillways are required to be constructed at bridge ends, they shall be constructed in the embankment slopes as described above and arranged so that they will connect to the bridge drains. The pipe shall be plain metal drain pipe 8-inch diameter and the joints shall be sealed with rubber gaskets conforming to the requirements of Section 9-04.4(4).

8-04.4 Measurement

All curbs, gutters, and spillways will be measured by the linear foot along the line and slope of the completed curbs, gutters, or spillways, including bends. Measurement of cement concrete curb and cement concrete curb and gutter, when constructed across driveways or sidewalk ramps, will include the width of the driveway or sidewalk ramp.

Except for metal spillways, excavation for these Structures shall be incidental to the items involved. Structure excavation required for the installation of metal spillways will be measured in accordance with the provisions of Section 2-09.

Hand placed riprap will be measured in accordance with Section 8-15.4.

8-04.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

- “Cement Conc. Traffic Curb and Gutter”, per linear foot.
- “Cement Conc. Traffic Curb”, per linear foot.
- “Mountable Cement Conc. Traffic Curb”, per linear foot.
- “Dual-Faced Cement Conc. Traffic Curb and Gutter”, per linear foot.
- “Dual-Faced Cement Conc. Traffic Curb”, per linear foot.
- “Cement Conc. Pedestrian Curb”, per linear foot.
- “Roundabout Central Island Cement Concrete Curb”, per linear foot.
- “Roundabout Truck Apron Cem. Conc. Curb and Gutter”, per linear foot.
- “Roundabout Truck Apron Cement Concrete Curb”, per linear foot.
- “Extruded Curb”, per linear foot.
- “Cement Conc. Gutter”, per linear foot.
- “Cement Conc. Spillway”, per linear foot.
- “Asphalt Conc. Gutter”, per linear foot.
- “Asphalt Conc. Spillway”, per linear foot.
- “Drain Pipe ___ In. Diam.”, per linear foot.
- “Half Round Plain St. Culv. Pipe ___ In. Th. ___ In. Diam.”, per linear foot.
- “Half Round Tr. 1 St. Culv. Pipe ___ In. Th. ___ In. Diam.”, per linear foot.
- “Half Round Plain Al. Culv. Pipe ___ In. Th. ___ In. Diam.”, per linear foot.
- “Half Round Tr. 1 Al. Culv. Pipe ___ In. Th. ___ In. Diam.”, per linear foot.
- “Hand Placed Riprap”, per cubic yard.

Hand placed riprap will be paid for as provided in Section 8-15.5.

When catch basin gutter pans are required in the Plans, all costs for providing the widened area of gutter pan shall be included in the curb and gutter Bid item.

8-05 VACANT

8-06 CEMENT CONCRETE DRIVEWAY ENTRANCES**8-06.1 Description**

This Work shall consist of constructing the types of cement concrete driveway entrances shown in the Plans and in accordance with these Specifications and the Standard Plans. The widths of the entrances shall be as noted in the Plans. When no width is noted in the Plans, the entrance shall be constructed to the minimum dimensions shown in the Standard Plans.

8-06.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregates	9-03
Premolded Joint Filler	9-04.1

8-06.3 Construction Requirements

Cement concrete driveway approaches shall be constructed with air entrained concrete Class 4000 conforming to the requirements of Section 6-02 or Portland Cement Concrete Pavement conforming to the requirements of Section 5-05.

Driveway entrance concrete may be placed, compacted, and finished using hand methods. The tools required for these operations shall be approved by the Engineer. After troweling and before edging, the surface of the driveway entrance shall be brushed in a transverse direction with a stiff bristled broom. Curing of the concrete shall be in accordance with Section 5-05.3(13). The driveway entrances may be opened to traffic in accordance with Section 5-05.3(17).

When noted in the Plans, the Contractor shall construct the driveway entrance in 2 or more segments to permit access to an existing driveway. At these locations, the Contractor shall provide a well-graded and drained temporary approach suitable for vehicular traffic from the abutting Roadway to the existing driveway and a firm surface for pedestrians crossing the approach. When the concrete in this segment of the entrance has reached the desired compressive strength, the Contractor shall route traffic over it, remove the temporary approach, and construct the remaining driveway entrance segment or segments. The joints between segments shall be filled to full cross-section with $\frac{3}{8}$ -inch premolded joint filler.

8-06.4 Measurement

Cement concrete driveway entrances will be measured by the square yard of finished surface.

8-06.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid item when it is included in the Proposal:

“Cement Conc. Driveway Entrance Type ____”, per square yard.

All costs in constructing the driveway entrance in segments and installing and removing the temporary approach shall be included.

8-07 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB**8-07.1 Description**

This Work consists of furnishing and installing precast traffic curb, block traffic curb, sloped mountable curb, or dual faced sloped mountable curb of the design and type specified in the Plans in accordance with these Specifications and the Standard Plans in the locations indicated in the Plans or as staked by the Engineer.

8-07.2 Materials

Materials shall meet the requirements of the following sections:

Paint	9-08.1
Precast Traffic Curb	9-18.1
Block Traffic Curb	9-18.3
Water Repellent Compound	9-18.4
Sodium Metasilicate	9-18.5
Mortar	9-20.4

8-07.3 Construction Requirements**8-07.3(1) Installing Curbs**

The curb shall be firmly bedded for its entire length and breadth on a mortar bed conforming to Section 9-20.4(3) composed of 1 part Portland cement and 2 parts of concrete sand. The anchor grooves in the bottom of the curb shall be entirely filled with the mortar.

Before the cement mortar bed is laid, all dirt shall be cleaned from the pavement surface by washing.

All old pavements and any portion of new pavements constructed under this Contract, which are covered with oil or grease within the curb limits, shall be further cleaned as follows:

1. The pavement shall be flushed with water.
2. While the pavement is still wet, sodium metasilicate, complying with the requirements as specified elsewhere herein, shall be evenly distributed over the pavement surface at a rate of 1 to 2-pounds per 100-square feet of pavement surface.
3. The sodium metasilicate shall remain on the pavement for at least 15-minutes. Where patches of oil, tar, or grease occur, these areas shall be scrubbed with a brush or broom.
4. The pavement surface shall then be thoroughly rinsed.

All joints between adjacent pieces of curb except joints for expansion and/or drainage as designated by the Engineer shall be filled with mortar composed of 1 part Portland cement and 2 parts sand.

The joints between adjacent units of block traffic curb will not require mortaring.

The alignment and the top surface of adjoining sections of curb shall be true and even with a maximum tolerance of $\frac{1}{16}$ -inch.

For both types of curb, nosing pieces, connecting dividers, and radial sections, as detailed in the Plans, will be required at the ends of the curb lines, at transitions from Type C traffic curb to Type A traffic curb, and at Type A traffic curb installation with radii less than 10-feet.

For sloped mountable curb installed in curves, the units shall be either curved blocks precast to the radii shown in the Plans or tangent blocks sawn to the dimensions shown in the Standard Plans to conform to the specified radii.

8-07.3(2) Painting of Curbs

Concrete curbing shall be painted with 2 full coats of paint conforming to Section 9-34.2, as shown in the Plans or as designated by the Engineer. The paint can be applied by brush or spray. The second coat shall have glass traffic paint beads sprinkled in the wet paint at the rate of 12-pounds per 100-linear foot of curbing. The beads shall conform to the requirements of Section 9-34.4.

8-07.4 Measurement

Type A precast traffic curb and Type A block traffic curb will be measured by the linear foot along the front face of the curb and return. Type C precast traffic curb and Type C block traffic curb will be measured by the linear foot along the axis of the curb. Type A nosing pieces and dividers will be measured as Type A curb, and Type C nosing pieces will be measured as Type C curb.

Sloped mountable curb will be measured by the linear foot along the front face of the curb. Dual faced sloped mountable curb will be measured by the linear foot of tapered block and nosing block installed. Only 1 face of dual faced curb will be measured.

8-07.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

- “Type A Precast Traffic Curb”, per linear foot.
- “Type C Precast Traffic Curb”, per linear foot.
- “Type A Block Traffic Curb”, per linear foot.
- “Type C Block Traffic Curb”, per linear foot.
- “Precast Sloped Mountable Curb”, per linear foot.
- “Precast Dual Faced Sloped Mountable Curb”, per linear foot.

8-08 RUMBLE STRIPS

8-08.1 Description

This Work consists of constructing centerline and shoulder rumble strips by grinding hot mix asphalt. The Work shall include cleanup and disposal of cuttings and other resultant debris. The Standard Plans show the patterns and construction details for the centerline rumble strip and the 4 types of shoulder rumble strips.

8-08.2 Vacant

8-08.3 Construction Requirements

The equipment shall have a rotary type cutting head or series of cutting heads capable of grinding 1 or more recesses in the hot mix asphalt as detailed in the Standard Plans. The difference in the surface texture between the high and low surfaces from the grinding shall not exceed $\frac{1}{8}$ -inch.

Rumble strips shall not be constructed on bridge decks, bridge approach slabs, or cement concrete surfaces. In areas where monuments, drainage structures, induction loop lead-ins, pavement markings or other features will not allow the rumble strips to be constructed as detailed, the rumble strips shall be eliminated or relocated as approved by the Project Engineer.

The traveled lanes shall be kept free of cuttings and other construction debris at all times. All cuttings, grinding debris, dust, and other loose materials shall become the property of the Contractor and, upon completion of rumble strip grinding, shall be immediately removed and disposed of outside the project limits. Cuttings and other debris shall not be allowed to enter any waterways.

When shown in the Plans, the rumble strips shall be fog sealed in accordance with the requirements of Section 5-02. Following the completion of the shoulder rumble strip. All pavement markings, junction boxes, drainage structures, and similar objects shall not be fog sealed.

The accumulative error in the longitudinal spacing of the rumble strips and the gaps, when required, shall not exceed plus or minus 5-percent.

8-08.4 Measurement

Centerline and shoulder rumble strips will be measured to the nearest 0.01-mile along the mainline roadway for centerline or each shoulder. No deductions will be made for required gaps shown on the Standard Plans or for the elimination of rumble strips across bridge decks, bridge approach slabs, cement concrete areas, or other areas approved by the Engineer.

Fog sealing, when shown in the Plans, will be measured as asphalt for fog seal in accordance with Section 5-02.4.

8-08.5 Payment

“Shoulder Rumble Strip Type __”, per mile.

“Centerline Rumble Strip”, per mile

Layout of the rumble strip pattern on the centerline or shoulders for grinding purposes is the responsibility of the Contractor. All costs involved in this Work shall be included in the appropriate Bid item.

Payment for fog sealing the shoulder, when shown in the Plans, shall be paid as asphalt for fog seal in accordance with Section 5-02.5.

8-09 RAISED PAVEMENT MARKERS

8-09.1 Description

This Work shall consist of furnishing and installing pavement markers of the type specified in the Plans, in accordance with these Specifications, and at the locations indicated in the Plans or where designated by the Engineer. This Work also includes cleanup and disposal of cuttings and other resultant debris. The color of pavement markers shall conform to the color of the marking for which they supplement, substitute for, or serve as a positioning guide for.

8-09.2 Materials

Raised pavement marker (RPM) shall meet the requirements of the following sections:

RPM Type 1	9-21.1
RPM Type 2	9-21.2
RPM Type 3	9-21.3
Adhesive	9-02.1, 9-26.2

8-09.3 Construction Requirements

8-09.3(1) Surface Preparation

All sand, dirt, and loose extraneous material shall be swept or blown away from the marker location and the cleaned surface prepared by 1 of the following procedures:

When deemed necessary by the Engineer all surface dirt within areas to receive markers shall be removed. Large areas of tar, grease, or foreign materials may require sandblasting, steam cleaning, or power brooming to accomplish complete removal.

When markers are placed on new cement concrete pavement, any curing compound shall be removed in accordance with the requirements of this section and Section 5-05.3(13)A.

The pavement shall be surface dry. When applying Epoxy Adhesives in cool weather the pavement surface shall be heated by intense radiant heat (not direct flame) for a sufficient length of time to warm the pavement areas of marker application to a minimum of 70°F.

Application of markers shall not proceed until final authorization is received from the Engineer.

8-09.3(2) Marker Preparation

Type 2 markers may be warmed prior to setting by heating to a maximum temperature of 120°F for a maximum of 10-minutes.

8-09.3(3) Adhesive Preparation

Epoxy adhesive shall be maintained at a temperature of 60°F to 85°F before use and during application.

Component A shall be added to component B just before use and mixed to a smooth uniform blend. The unused mixed adhesive shall be discarded when polymerization has caused stiffening and reduction of workability.

Bituminous pavement marker adhesive shall be indirectly heated in an applicator with continuous agitation or recurring circulation. Adhesive temperature shall not exceed the maximum safe heating temperature stated by the manufacturer. The Contractor shall provide the Engineer with manufacturers written instruction for application temperature and maximum safe heating temperature.

8-09.3(4) Application Procedure

8-09.3(4)A Epoxy Adhesives

The marker shall be affixed to the prepared pavement area with sufficient adhesive so as to squeeze out a small bead of adhesive around the entire periphery of the marker. The required amount of adhesive per marker will normally be in the range of 20 to 40-grams.

The sequence of operations shall be as rapid as possible. Adhesive shall be in place and the marker seated in not more than 30-seconds after the removal of the pavement preheat or warm air blast. The marker shall not have cooled more than 1-minute before seating.

The length of the pavement preheat or warming shall be adjusted so as to ensure bonding of the marker in not more than 15-minutes. Bonding will be considered satisfactory when adhesive develops a minimum bond strength in tension of not less than 800-grams per square inch or a total tensile strength of 25-pounds

Markers shall be spaced and aligned as shown in the Standard Plans and as specified by the Engineer. A displacement of not more than ½-inch left or right of the established guide line will be permitted. The Contractor shall remove and replace at no expense to the Contracting Agency all improperly placed markers.

Markers shall not be placed over longitudinal or transverse joints in the pavement surface.

On Roadway sections which are not open to public traffic, the preheating of the markers by dry heating before setting will not be required provided the adhesive develops the required bond strength of 800-grams per square inch in less than 3-hours. If the Roadway section is carrying public traffic during the installation of the markers, the 15-minute set-to-traffic provision will be enforced, and necessary flagging and traffic control will be required.

8-09.3(4)B Asphalt Adhesives

Thermoplastic Type 1 markers shall be installed only with a hot melt bitumen adhesive. At the option of the Contractor, a hot melt bitumen adhesive may be used to cement other types of markers to the pavement in lieu of epoxy adhesive. The bitumen adhesive shall conform to the requirements of Section 9-02.1(8).

Bituminous adhesive shall be applied at temperatures recommended by the manufacturer.

Markers shall be placed immediately after application of the adhesive.

8-09.3(5) Recessed Pavement Marker

The Contractor shall construct recesses for pavement markers by grinding the pavement in accordance with the dimensions shown in the Standard Plans. The Contractor shall prepare the surface in accordance with Section 8-09.3(1), and install Type 2 markers in the recess in accordance with the Standard Plans and Section 8-09.3(4).

8-09.4 Measurement

Measurement of markers will be by units of 100 for each type of marker furnished and set in place.

8-09.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Raised Pavement Marker Type 1”, per hundred.

“Raised Pavement Marker Type 2”, per hundred.

“Raised Pavement Marker Type 3-_____ In.”, per hundred.

“Recessed Pavement Marker”, per hundred.

The unit Contract price per hundred for “Raised Pavement Marker Type 1”, “Raised Pavement Marker Type 3 _____ In.”, and “Recessed Pavement Marker” shall be full pay for furnishing and installing the markers in accordance with these Specifications including all cost involved with traffic control except for reimbursement for other traffic control labor, and for flaggers and spotters in accordance with Section 1-10.5.

8-10 GUIDE POSTS

8-10.1 Description

This Work shall consist of furnishing and placing flexible guide posts of the type specified in the Plans in accordance with these Specifications and the Standard Plans, at the locations indicated in the Plans or where designated by the Engineer.

8-10.2 Materials

Flexible guide posts and reflective sheeting shall be selected from approved materials listed in the Special Provisions or the Qualified Products List. Flexible guide posts shall be pre-approved in accordance with Section 9-17 prior to use on a project. If a producer lacks access to a regularly conducted State Materials Laboratory test, the producer may submit for consideration, performance data gained from independent testing attested by a registered Engineer. Acceptance of independent data or repetition of selected or total tests, shall be the prerogative of the State Materials Laboratory.

Adhesives for surface mounted guide posts shall meet the requirements of Sections 9-02.1(8) or 9-26.2. Other bonding agents may be approved by the Engineer.

8-10.3 Construction Requirements

Flexible guide posts shall be installed as shown in the Standard Plans or as specified by the Engineer. The posts shall be installed plumb, plus or minus 1½-degrees.

Guide posts shall be of such length as to provide a height of 48-inches, plus or minus 3-inches, above the nearest edge of traveled pavement surface. Surface mounted guide posts shall be bonded to the pavement surface. The final guide posts lengths will be determined or verified by the Engineer at the request of the Contractor.

Flexible guide posts shall be installed according to the manufacturer's recommendations. A reasonable time prior to installation, the Contractor shall provide the Engineer with the manufacturer's recommended installation procedures. Only 1 type of ground mount or guardrail mount flexible guide post shall be used on each project.

If the ground adjacent to the posts is disturbed in any manner, it shall be backfilled to the level of the existing surface and thoroughly compacted. The surface of the ground adjacent to the post shall be replaced with like materials, including bituminous treatment if previously existent.

8-10.4 Measurement

Flexible guide posts will be measured by the unit for each post furnished and installed.

8-10.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid item when included in the Proposal:

“Flexible Guide Post”, per each.

8-11 GUARDRAIL

8-11.1 Description

This Work consists of constructing, modifying, removing, and resetting guardrail and anchors of the kind and type specified in accordance with the Plans, these Specifications, and the Standard Plans in conformity with the lines and grades as staked.

8-11.2 Materials

Materials shall meet the requirements of the following sections:

Beam Guardrail	9-16.3
Rail Element	9-16.3(1)
Posts and Blocks	9-16.3(2)
Galvanizing	9-16.3(3)
Hardware	9-16.3(4)
Anchors	9-16.3(5)
Weathering Steel Beam Guardrail	9-16.8

8-11.3 Construction Requirements

8-11.3(1) Beam Guardrail

8-11.3(1)A Erection of Posts

The posts shall be set to the true line and grade of the Highway and spaced as shown in the Plans. When the Plans require that the ends of a section of guardrail be curved outward or downward, the posts shall be set to accommodate the curve. End treatment shall be in accordance with the appropriate Standard Plans or as shown in the Plans.

The length of post installed shall be as shown in the Standard Plans unless long posts are indicated. The length of the posts for beam guardrail with long posts shall be as shown in the Plans.

Posts may be placed in dug or drilled holes. Ramming or driving will be permitted only if approved by the Engineer and if no damage to the pavement, Shoulders, and adjacent slopes results there from.

In broken rock embankments, the pre-punching of holes will be permitted only prior to final Shoulder or median compaction, surfacing, and paving.

The posts shall be protected from traffic at all times by attaching the rail elements or by a method approved by the Engineer.

8-11.3(1)B Vacant

8-11.3(1)C Erection of Rail

All metal work shall be fabricated in the shop. No punching, cutting, or welding shall be done in the field, except that holes necessary when additional posts are required or for special details in exceptional cases may be drilled in the field when approved by the Engineer. The rail shall be erected so that the bolts at expansion joints will be located at the centers of the slotted holes. Except in Weathering Steel Beam Guardrail, all holes shall be painted with 2 coats of paint conforming to Section 9-08.1(2)B.

Rail plates shall be assembled with the splice joints lapping in the direction of the traffic.

When nested W-beam or thrie beam is specified, 2 sections of guardrail, 1 set inside of the other shall be installed. The inside and outside rail elements shall not be staggered.

Galvanized and weathering steel rail plates shall be fastened to the posts with galvanized bolts, washers, and nuts of the size and kind shown in the Plans.

All bolts, except where otherwise required at expansion joints, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being

tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least ¼-inch beyond the nuts. Except where required for adjustments, bolts shall not extend more than ½-inch beyond the nuts.

After complete installation of weathering steel beam guardrail, the Contractor shall wash the rail with clean water under high pressure. If the rail is contaminated by oil or grease, sandblasting shall be used as necessary to clean the rail.

8-11.3(1)D Terminal and Anchor Installation

All excavation and backfilling required for installation of anchors shall be performed in accordance with Section 2-09, except that the costs thereof shall be incidental to and included in the unit Contract price for the type of anchor installed.

Bolts shall be tightened to the tension specified. The anchor cable shall be tightened sufficiently to eliminate all slack. When tightening, the anchor cable shall be restrained to prevent twisting of the cable.

When foundation tubes used with the Wood Breakaway Post are driven, they shall be driven prior to installing the wood post.

Type 2 concrete anchors may either be precast or cast-in-place at the option of the Contractor.

Assembly and installation of Beam Guardrail Flared Terminals and Beam Guardrail Non-flared Terminals shall be supervised at all times by a manufacturer's representative, or an installer who has been trained and certified by the manufacturer. A copy of the installer's certification shall be provided to the Engineer prior to installation. Assembly and installation shall be in accordance with the manufacturer's recommendations.

8-11.3(1)E Plans

The Contractor shall submit for approval of the Engineer such additional detailed plans and shop drawings of rail punching, fittings, and assemblies as may be required by the Engineer.

8-11.3(2) Guardrail Construction Exposed to Traffic

Any section of beam guardrail that is removed for modification shall be back in place within 5-calendar days of the date the guardrail is removed.

The Contractor's operations shall be conducted in such a manner that fixed objects and beam guardrail posts shall be protected from traffic at all times by attachment of the rail elements and all associated hardware or by a method approved by the Engineer.

At the end of each day, guardrail sections having an exposed end toward oncoming traffic shall have a Type G terminal end section bolted securely in place.

8-11.3(3) Access Control Gates

Access control gates shall be placed to line and grade as shown in the Plans or as staked. After the posts have been set, the holes shall be backfilled with suitable material and the material thoroughly tamped.

8-11.3(4) Removing Guardrail and Guardrail Anchor

Removal of the various types of guardrail shall include removal of the rail, cable elements, hardware, and posts, including transition sections, expansion sections and terminal sections. Removal of the various types of guardrail anchors shall include removal of the anchor assembly in its entirety, including concrete bases, rebar, and steel tubes and any other appurtenances in the anchor assembly. All holes resulting from the removal of the guardrail posts and anchors shall be backfilled with granular material in layers no more than 6-inches thick and compacted to a density similar to that of the adjacent material. The removed guardrail items shall become the property of the Contractor.

The embedded anchors attaching guardrail posts and guardrail terminal sections specified for removal to existing concrete Structures shall be removed a minimum of 1-inch beneath the existing concrete surface. The void left by removal of the embedded anchors shall be coated with epoxy bonding agent and filled with mortar conforming to Section 9-20.4(2). The epoxy bonding agent shall be Type II, conforming to Section 9-26.1, with the grade and class as recommended by the epoxy bonding agent manufacturer and as approved by the Engineer. The mortar shall consist of cement and fine aggregate mixed in the proportions to match the color of the existing concrete surface as near as practicable.

8-11.3(5) Raising Guardrail

For raising guardrail anchors and raising guardrail terminals, the existing guardrail posts shall be raised to attain the guardrail height shown in the Plans, measured from the top of the rail to the finished Shoulder surface. The material around each post shall be tamped to prevent settlement of the raised post.

For raising all other guardrail, the existing guardrail posts shall not be raised to attain the new mounting height. The existing rail elements and blocks shall be removed from the guardrail post. The Contractor shall field drill new 3/4-inch diameter holes in the existing posts to accommodate the 3/4-inch diameter button head bolts. When existing guardrail posts are galvanized steel, the new drill holes shall be painted with 2 coats of paint, conforming to Section 9-08.1(2)B. The Contractor shall then reinstall the guardrail block and rail element at the new mounting height shown in the Plans, measured from the top of the rail to the finished Shoulder surface. The new position of the top of the block shall not be more than 4-inches above the top of the guardrail post

The Contractor shall remove and replace any existing guardrail posts and blocks that are not suited for re-use, as staked by the Engineer. The void caused by the removal of the post shall be backfilled and compacted. The Contractor shall then furnish and install a new guardrail post to provide the necessary mounting height.

8-11.4 Measurement

Measurement of beam guardrail and beam guardrail with long posts will be by the linear foot measured along the line of the completed guardrail, including expansion section, and will also include the end section for F connections.

Measurement of beam guardrail transition sections will be per each for the type of transition section installed. End sections, except for F connections, will be considered part of the transition section and will be included in the measurement of the transition section.

Measurement of beam guardrail _____ terminal and beam guardrail buried terminal Type 1 will be per each for the completed terminal.

Measurement of beam guardrail buried terminal Type 2 will be per linear foot for the completed terminal.

Measurement of beam guardrail placement-25-foot span will be per each for the completed span.

Measurement of beam guardrail anchors of the type specified will be per each for the completed anchor, including the attachment of the anchor to the guardrail.

Access control gates will be measured per each.

Measurement of removal of guardrail will be by the linear foot measured along the line of guardrail removed including transition sections, expansion sections, and terminal sections.

Measurement of removal of guardrail anchors will be per each.

Measurement of raising beam guardrail and removing and resetting beam guardrail will be by the linear foot measured along the line of guardrail actually raised or removed

and reset. This will include transition sections, expansion sections, anchors, and terminal sections.

Measurement of beam guardrail post used for raising beam guardrail will be per each.

Measurement of beam guardrail blocks used for raising beam guardrail will be per each.

8-11.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Beam Guardrail Type _____”, per linear foot.

“Beam Guardrail Type 1- _____ Ft. Long Post”, per linear foot.

“Beam Guardrail Type 31- _____ Ft. Long Post”, per linear foot.

“Weathering St. Beam Guardrail Type _____”, per linear foot.

The unit Contract price per linear foot for “Beam Guardrail Type _____”, “Beam Guardrail Type 1- _____ Ft. Long Post”, “Beam Guardrail Type 31- _____ Ft. Long Post”, or “Weathering St. Beam Guardrail Type _____” shall include all CRT posts, additional rail elements when nested rail is required, and connection to concrete masonry Structures.

“Beam Guardrail Anchor Type _____”, per each.

“Beam Guardrail Transition Section Type _____”, per each.

The unit Contract price per each for “Beam Guardrail Transition Section Type _____” shall include posts, end sections, and connection to masonry Structures.

“Beam Guardrail _____ Terminal”, per each.

“Beam Guardrail Buried Terminal Type 1”, per each.

“Beam Guardrail Buried Terminal Type 2”, per linear foot.

The unit Contract price for “Beam Guardrail _____ Terminal”, “Beam Guardrail Buried Terminal Type 1” and “Beam Guardrail Buried Terminal Type 2” shall include the posts, rail, end section, and anchor.

“Beam Guardrail Placement - 25' Span”, per each.

The unit Contract price per each for “Beam Guardrail Placement - 25' Span”, shall include all CRT posts, Type 1 guardrail posts and blocks and all nested w-beam rail elements.

“Access Control Gate”, per each.

“Removing and Resetting Beam Guardrail”, per linear foot.

“Raising Existing Beam Guardrail”, per linear foot.

The unit Contract price per linear foot for “Raising Existing Beam Guardrail”, per linear foot shall be full pay for raising existing posts, compacting existing material, field drilling existing posts, raising guardrail and blocks, furnishing and installing new bolts, painting galvanized steel posts with galvanizing paint, and replacing any hardware that is damaged or missing but is required to provide a complete installation.

“Removing Guardrail”, per linear foot.

“Removing Guardrail Anchor”, per each.

“Beam Guardrail Post”, per each.

The unit Contract price per each for “Beam Guardrail Post” shall include furnishing and installing the new post, removal and disposal of the existing post, and backfilling and compacting the void created by the post removal.

“Beam Guardrail Block”, per each.

The unit Contract price per each for “Beam Guardrail Block” shall include furnishing and installing the new block, and removal and disposal of the existing block.

8-12 CHAIN LINK FENCE AND WIRE FENCE

8-12.1 Description

This Work consists of furnishing and constructing chain link fence and wire fence of the types specified in accordance with the Plans, these Specifications, and the Standard Plans at the locations shown in the Plans and in conformity with the lines as staked.

Chain link fence shall be of diamond woven wire mesh mounted on steel posts.

Wire fence shall be of barbed wire or barbed wire combined with wire mesh fastened to posts. Steel posts and steel braces, or wood posts and wood braces may be used, provided only 1 type shall be selected for use in any Contract.

Gates shall consist of a steel frame or frames covered with chain link or wire mesh.

8-12.2 Materials

Materials shall meet the requirements of the following sections:

Concrete	6-02
Chain Link Fence and Gates	9-16.1
Wire Fence and Gates	9-16.2
Grout	9-20.3

8-12.3 Construction Requirements

Clearing of the fence line will be required. Clearing shall consist of the removal and disposal of all trees, brush, logs, upturned stumps, roots of down trees, rubbish, and debris.

For chain link type fences, the clearing width shall be approximately 10-feet. For wire type fences, the clearing width shall be approximately 3-feet. Grubbing will not be required except where short and abrupt changes in the ground contour will necessitate removal of stumps in order to properly grade the fence line. All stumps within the clearing limits shall be removed or close cut.

Grading of the fence line sufficient to prevent short and abrupt breaks in the ground contour that will improve the aesthetic appearance of the top of the fencing when installed shall be required. It is expected that in the performance of this Work, machine operations will be required for chain link fencing, and handwork will be required for wire fencing except where sufficient width exists for machine work.

The fence shall be constructed close to and inside the Right of Way line unless otherwise directed by the Engineer or shown in the Plans. Deviations in alignment to miss obstacles will be permitted only when approved by the Engineer and only when such deviation will not be visible to the traveling public or adjacent property owners.

8-12.3(1) Chain Link Fence and Gates

8-12.3(1)A Posts

Posts shall be placed in a vertical position and, except where otherwise directed by the Engineer, shall be spaced at 10-foot centers. Spacing will be measured parallel to the slope of the ground.

All posts, except line posts for Type 3 and Type 4 fences, shall be set in concrete to the dimensions shown in the Plans. All concrete footings shall be crowned so as to shed water. Line posts on Type 3 and Type 4 fences shall be set in undisturbed earth either by driving or drilling, except as specified. Driving shall be accomplished in such a manner as not to damage the post. Voids around the post shall be backfilled with suitable material and thoroughly tamped.

Concrete footings shall be constructed to embed the line posts on Type 3 and Type 4 fences at grade depressions where the tension on the fence will tend to pull the post from the ground.

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 14-inches, and end, corner, gate, brace, and pull posts a minimum of 20-inches into the solid rock. The holes shall have a minimum width 1-inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths that will give the required length of post above ground, or if the Contractor so elects, an even length of post set at a greater depth into the solid rock may be used.

After the post is set and plumbed, the hole shall be filled with grout, conforming to Section 9-20.3(4), consisting of 1 part Portland cement and 3 parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water from the post.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth shown in the Plans unless penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. Concrete footings shall be constructed from the solid rock to the top of the ground. Grouting will be required on the portion of the post in solid rock.

Pull posts shall be spaced at 1,000-foot maximum intervals for Type 1, 3, and 6 fence, and at 500-foot maximum intervals for Type 4 fence.

Gate and pull posts shall be braced to the adjacent brace, end, or corner post(s) in the manner shown in the Plans. Changes in line amounting to 2-foot tangent offset or more between posts shall be considered as corners for all types of fence.

Steep slopes or abrupt topography may require changes in various elements of the fence. It will be the responsibility of the Contractor to provide all posts of sufficient length to accommodate the chain link fabric and ornamental tops adapted to receive the top rail.

All posts for Types 1 and 6 chain link fence shall be fitted with an approved top cap designed to fit securely over the post to support the top rail. All round posts for Types 3 and 4 chain link fence shall have approved top caps fastened securely to the posts. The base of the top cap fitting for round posts shall feature an apron around the outside of the posts.

8-12.3(1)B Top Rail

Top rails shall pass through the ornamental tops of the line posts, forming a continuous brace from end to end of each stretch of fence. Lengths of tubular top rail shall be joined by sleeve couplings. Top rails shall be securely fastened to terminal posts by pressed steel fittings or other appropriate means.

8-12.3(1)C Tension Wire and Tension Cable

Tension Wires shall be attached to the posts as detailed in the Plans or as approved by the Engineer.

Tension Cables shall be installed in accordance with Section 8-25.3(5).

8-12.3(1)D Chain Link Fabric

Attach the chain link fabric after the cables and wires have been properly tensioned and/or the top rail has been installed.

Chain link fabric on Type 1, 3, 4, and 6 fence shall be placed on the face of the post away from the Highway, except on horizontal curves where it shall be placed on the side designated by the Engineer.

Chain link fabric on Type 1, 3, 4, and 6 fences shall be placed approximately 1-inch above the ground and on a straight grade between posts by excavating high points of ground. Filling of depressions will be permitted only upon approval of the Engineer.

The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and fabric bands spaced at intervals of 15-inches or less or by weaving the fabric into the fastening loops of roll formed posts. Fastening to posts shall be with tie wire, metal bands, or other approved method attached at 14-inch intervals. The top and bottom edge of the fabric shall be fastened with tie wires to the top rail and with hog rings to the tension cable or top and bottom tension wires as may be applicable, spaced at 24-inch intervals.

Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

8-12.3(1)E Chain Link Gates

Chain link fabric shall be fastened to the end bars of the gate frame by stretcher bars and fabric bands and to the top and bottom bars of the gate frames by tie wires in the same manner as specified for the chain link fence fabric, or by other standard methods if approved by the Engineer.

Welded connections on gate frames where the galvanized coating has been burned shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed. The clean areas shall then be painted with 2 coats of paint, conforming to Section 9-08.1(2)B.

The drop bar locking device for the wire gates shall be provided with a 12-inch round by 18-inch deep footing of commercial concrete, crowned at the top and provided with a hole to receive the locking bar. The depth of the penetration of the locking bar into the footing shall be as specified by the manufacturer of the locking device.

8-12.3(2) Wire Fence and Gates

8-12.3(2)A Posts

Line posts shall be spaced at intervals not to exceed 14-feet. All intervals shall be measured center to center of posts. In general, in determining the spacing of posts, measurements will be made parallel to the slope of the existing ground, and all posts shall be placed in a vertical position except where otherwise directed by the Engineer.

Line posts may be driven in place provided the method of driving does not damage the post. Steel corner, gate, and pull posts shall be set in commercial concrete footings to the dimensions shown in the Plans and crowned at the top to shed water.

Concrete footings shall be constructed to embed the lower part of steel line posts, and wood anchors shall be placed on wood posts at grade depressions wherever the tension on the line wires will tend to pull the post from the ground. The concrete footings shall be 3-feet deep by 12-inches in diameter and crowned at the top.

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 14-inches and end, corner, gate, and pull posts a minimum depth of 20-inches into the solid rock. The hole shall have a minimum dimension 1-inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths that will give 4½-feet of post above ground, or if the Contractor so elects, 6-foot posts set 18-inches into the solid rock may be used.

After the post is set and plumbed, the hole shall be filled with grout consisting of 1 part Portland cement and 3 parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water away from the post. Where posts are set in the above manner, anchor plates and concrete footings will not be required.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth of 2½-feet unless the penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. When the depth of the overburden is greater than 12-inches, anchor plates will be required on the steel line posts, and concrete footings shall be constructed from the solid rock to the top of the ground on steel end, gate, corner, and pull posts. When the depth of overburden is 12-inches or less, anchor plates and concrete footings will not be required. Grouting will be required on the portion of the post in solid rock.

Steel braces shall be anchored to soil or loose rock with a commercial concrete footing not less than 18-inches on any 1 side and set in solid rock to a minimum depth of 10-inches in the same manner as specified above for posts. The braces shall be set on the diagonal as shown in the Plans and connected to the post with an approved connection.

Wood braces shall be dapped ¼-inch into the posts and shall be fastened to each post with three 20d galvanized nails.

Wire braces shall consist of a 9-gage wire passed around the wood posts to form a double wire. The wire shall be fastened to each post with 2 staples and fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the 2 shall be attached in a manner satisfactory to the Engineer, end or corner posts being set as necessary.

Pull posts shall be spaced not more than 1,000-feet apart, but spacing shall be such as to use standard rolls of wire mesh with a minimum of cutting and waste.

Changes in alignment of 30-degrees or more shall be considered as corners, and corner posts shall be installed. Where it is deemed by the Engineer that a change in alignment of less than 30-degrees will materially lessen the strength of the fence, the line post at the angle shall be supported by the addition of braces or wires in a manner satisfactory to the Engineer.

8-12.3(2)B Barbed Wire and Wire Mesh

After the pull posts have been placed and securely braced, the barbed wire and mesh shall be pulled taut to the satisfaction of the Engineer, and each longitudinal wire shall be cut and securely fastened to the pull post with devices customarily used for the purpose. Wire or mesh shall not be carried past a pull post, but shall be cut and fastened to the pull post independently for the adjacent spans.

After the tensioning of the wire or mesh between 2 pull posts, all longitudinal wires shall be properly fastened at proper height to each intervening line post.

Wire mesh and barbed wire shall be placed on the face of the post which is away from the highway, except that on horizontal curves, the mesh and wires shall be fastened to the face on the outside of the curve unless otherwise directed by the Engineer.

Where unusual ground depressions occur between posts, the fence shall be guyed to the ground by means of a 9-gage galvanized wire attached to a deadman of approximately 100-pounds buried 2-feet in the ground. The guy wire shall be securely attached to each strand of barbed wire and to the top and bottom wires of the wire mesh fabric in a manner to maintain the entire fence in its normal shape. If necessary to guy the fence in solid rock, the guy wire shall be grouted in a hole 2-inches in diameter and 10-inches deep. The operation of guying shall leave the fence snug with the ground.

8-12.3(2)C Vertical Cinch Stays

Vertical cinch stays shall be installed midway between posts on both types of fence. The wire shall be twisted in such a manner as to permit weaving into the horizontal fence wires to provide rigid spacing. All barbed wires and the top, middle, and bottom wire of the wire mesh shall be woven into the stay.

8-12.3(2)D Wire Gates

The wire mesh fabric shall be taut and securely tied to the frame and stays in accordance with recognized standard practice for wire gate construction.

Welded connections on gate frames shall be treated as specified for chain link fence gates.

The drop bar locking device for double wire gates shall be provided with a footing of commercial concrete 12-inches in diameter and 12-inches deep, crowned on top and provided with a hole to receive the locking bar. The diameter and depth of the hole in the footing shall be as specified by the manufacturer of the locking device.

8-12.4 Measurement

Chain link fence and wire fence will be measured by the linear foot of completed fence, along the ground line, exclusive of openings.

End, gate, corner, and pull posts for chain link fence will be measured per each for the posts furnished and installed complete in place.

Gates will be measured by the unit for each type of gate furnished and installed.

8-12.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Chain Link Fence Type _____”, per linear foot.

Payment for clearing of fence line for “Chain Link Fence Type _____” shall be in accordance with Section 2-01.5.

“End, Gate, Corner, and Pull Post for Chain Link Fence”, per each.

“Double 14 Ft. Chain Link Gate”, per each.

“Double 20 Ft. Chain Link Gate”, per each.

“Single 6 Ft. Chain Link Gate”, per each.

“Wire Fence Type _____”, per linear foot.

Payment for clearing of fence line for wire fence shall be included in the unit Contract price per foot for “Wire Fence Type _____”.

“Single Wire Gate 14 Ft. Wide”, per each.

“Double Wire Gate 20 Ft. Wide”, per each.

8-13 MONUMENT CASES**8-13.1 Description**

This Work consists of furnishing and placing monument cases and covers, in accordance with the Standard Plans and these Specifications, in conformity with the lines and locations shown in the Plans or as staked.

8-13.2 Materials

Materials shall meet the requirements of the following sections:

Concrete	6-02
Monument Cases and Covers	9-22.1

8-13.3 Construction Requirements

The concrete base shall be placed on a well compacted foundation. The placing of the monument case and base shall be performed in a manner that will not disturb the monument.

The monument case shall be installed by the Contractor after the final course of surfacing has been placed. After the monument case has been in place for a minimum of 3-days, the Roadway surface shall be patched in a workmanlike manner.

When the monument case and cover are placed in cement concrete pavement, the concrete base will not be required.

The monument will be furnished and set by the Engineer.

8-13.4 Measurement

Measurement of monument case and cover will be by the unit for each monument case and cover furnished and set.

8-13.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid item when included in the Proposal:

“Monument Case and Cover”, per each.

8-14 CEMENT CONCRETE SIDEWALKS

8-14.1 Description

This Work consists of constructing cement concrete sidewalks in accordance with details shown in the Plans and these Specifications and in conformity to lines and grades shown in the Plans or as established by the Engineer.

8-14.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregates	9-03
Premolded Joint Filler	9-04.1
Concrete Curing Materials and Admixtures	9-23

8-14.3 Construction Requirements

The concrete in the sidewalks and curb ramps shall be air entrained concrete Class 3000 in accordance with the requirements of Section 6-02.

8-14.3(1) Excavation

Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown in the Plans. All soft and yielding material shall be removed and replaced with acceptable material.

8-14.3(2) Forms

Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp, and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. After the forms have been set to line and grade, the foundation shall be brought to the grade required and thoroughly wetted approximately 12-hours before placing the concrete.

8-14.3(3) Placing and Finishing Concrete

The concrete shall be placed in the forms and struck off with an approved straightedge. As soon as the surface can be worked, it shall be troweled smooth with a steel trowel.

After troweling and before installing the contraction joints or perimeter edging, the walking surfaces of the sidewalk and curb ramps shall be brushed in a transverse direction with a stiff bristled broom as shown in the Plans.

Expansion and contraction joints shall be constructed as shown in the Plans. When the sidewalk abuts a cement concrete curb or curb and gutter, the expansion joints in the sidewalk shall have the same spacing as the curb. The expansion joint shall be filled to full cross-section of the sidewalk with $\frac{3}{8}$ -inch premolded joint filler.

Curb ramps shall be of the type specified in the Plans and shall include the detectable warning surface. The detectable warning surface shall have the truncated dome shape shown in the Plans and may be installed using a manufactured material before or after the concrete has cured, or by installing masonry or ceramic tiles. Embossing or stamping the wet concrete to achieve the truncated dome pattern or using a mold into which a catalyst hardened material is applied shall not be allowed. Acceptable manufacturers' products are shown on the Qualified Products List.

When masonry or ceramic tiles are used to create the detectable warning surface, the Contractor shall block out the detectable warning surface area to the depth required for installation of the tiles and finish the construction of the concrete curb ramp. After the concrete has set and the forms have been removed, the Contractor shall install the tiles using standard masonry practices.

The 2-foot wide detectable warning surface area on the curb ramp shall be yellow and shall match Federal Standard 595, color number 33538. When painting the detectable warning surface is required, paint shall conform to Section 9-34.2(1).

8-14.3(4) Curing

Concrete sidewalks shall be cured for at least 72-hours. Curing shall be by means of moist burlap or quilted blankets or other approved methods. During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as the Engineer may specify.

8-14.3(5) Curb Ramp Detectable Warning Surface Retrofit

Where shown in the Plans, the Contractor shall retrofit existing cement concrete curb ramps by installing a detectable warning surface having the truncated dome shape shown in the Plans. The detectable warning surface shall be the width of the curb ramp and cover the bottom 2-feet of the curb ramp. The truncated dome pattern shall be perpendicular to the long axis of the curb ramp.

The Contractor shall use 1 of the detectable warning surface products listed in the Qualified Products List or submit another manufacturer's product for approval by the Engineer. The detectable warning surface shall be capable of being bonded to an existing cement concrete surface. The surface of the detectable warning surface, excluding the domes, shall not be more than $\frac{3}{8}$ -inch above the surface of the concrete after installation.

8-14.4 Measurement

Cement concrete sidewalks will be measured by the square yard of finished surface and will not include the surface area of the curb ramps. Measurement of curb ramps will be by the unit for each complete curb ramp type.

Curb ramp detectable warning surface retrofit will be measured by the square foot of truncated dome material installed on the existing curb ramp.

8-14.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid items when included in the Proposal:

"Cement Conc. Sidewalk", per square yard.

"Cement Conc. Sidewalk with Raised Edge", per square yard.

"Monolithic Cement Conc. Curb and Sidewalk", per square yard.

"Cement Conc. Curb Ramp Type ____", per each

Payment for excavation of material not related to the construction of the sidewalk but necessary before the sidewalk can be placed, when and if shown in the Plans, will be made in accordance with the provisions of Section 2-03. Otherwise, the Contractor shall make all excavations including haul and disposal, regardless of the depth required for constructing the sidewalk and curb ramps to the lines and grades shown, and shall include all costs thereof in the unit Contract price per square yard for "Cement Conc. Sidewalk", "Cement Conc. Sidewalk with Raised Edge", "Monolithic Cement Conc. Curb and Sidewalk", or the unit contract price per each for "Cement Concrete Curb Ramp Type ____".

"Curb Ramp Detectable Warning Surface Retrofit", per square foot.

8-15 RIPRAP

8-15.1 Description

This Work consists of furnishing and placing riprap protection of the type specified at the locations and in conformity with the lines and dimensions shown in the Plans or established by the Engineer.

Riprap will be classified as heavy loose riprap, light loose riprap, hand placed riprap, and sack riprap.

8-15.2 Materials

Materials shall meet the requirements of the following sections:

Filter Blanket ____ (shall meet the gradation requirements for Permeable Ballast)	9-03.9(2)
Gravel Backfill for Drains	9-03.12(4)
Heavy Loose Riprap	9-13.1(1)
Light Loose Riprap	9-13.1(2)
Hand Placed Riprap	9-13.2
Sack Riprap	9-13.3
Quarry Spalls	9-13.6

8-15.3 Construction Requirements

8-15.3(1) Excavation for Riprap

The foundation for riprap shall be excavated below probable scour or to the elevation shown in the Plans, and no stone shall be laid or concrete placed until the footing is approved by the Engineer. Excavation below the level of the intersection of the slope to be protected and the adjacent original ground or the channel floor or slope shall be classified, measured, and paid for as channel excavation or ditch excavation in accordance with Section 2-03. All excavation or backfill above the level of the above described intersection and all dressing of the slope to be protected shall be included in the Contract price for the class of riprap to be placed. Before placing riprap, the slopes shall be dressed to the lines and grades as staked.

8-15.3(2) Loose Riprap

Loose riprap shall be placed in such a manner that all relatively large stones shall be essentially in contact with each other, and all voids filled with the finer materials to provide a well graded compact mass. The stone shall be dumped on the slope in a manner that will ensure the riprap attains its specified thickness in 1 operation. When dumping or placing, care shall be used to avoid disturbing the underlying material. Placing in layers parallel to the slope will not be permitted. A 12-inch tolerance for loose riprap will be allowed from slope plane and grade line in the finished surface.

8-15.3(3) Hand Placed Riprap

The stones shall be laid by hand on prepared slopes to such thickness as may be ordered by the Engineer. The riprap shall be started at the toe of the embankment by digging a trench and placing a course of the largest stones therein. Each stone shall be placed so that it shall rest on the slope of the embankment and not wholly on the stone below, and it shall be thoroughly tamped or driven into place. The exposed face of all hand placed riprap shall be made as smooth as the shape and size of the stones will permit and shall not vary more than 3-inches from a plane surface on the required slope.

8-15.3(4) Sack Riprap

Sack riprap conforming to the requirements of Section 9-13.3 shall be deposited in the trench and on the slope of the embankment to be protected in accordance with the Plans or as ordered by the Engineer in accordance with Section 1-04.4.

The concrete shall be placed in the sacks to a uniform volume leaving sufficient room for effectively tying the sacks. The sacks shall then be placed in longitudinal rows in the trench and on the slope to lie parallel with the slope. In placing the sacks on the slope, their outside faces shall be laid against a heavy timber header or screed so that each layer will be true to line and grade. The tied end of the sack shall be turned under and the sack firmly pressed into place against the header or screed. Sacks in the longitudinal rows shall be placed with the bottom of 1 sack adjacent to the top of the next sack. Joints shall be staggered in succeeding rows. Sack riprap shall not be placed in freezing weather, and Work damaged by frost shall be removed and replaced at the Contractor's expense.

8-15.3(5) Vacant**8-15.3(6) Quarry Spalls**

Quarry spalls shall be placed in ditches and on slopes to be protected, in accordance with the Plans or as staked by the Engineer. After placement, the quarry spalls shall be compacted to be uniformly dense and unyielding.

8-15.3(7) Filter Blanket

When required, a filter blanket shall be placed on the prepared slope or area to the full thickness specified in the Plans using methods which will not cause segregation of particle sizes within the bedding. The surface of the finished layer shall be even and free from mounds or windrows. Additional layers of filter material, when required, shall be placed using methods that will not cause mixing of the materials in the different layers.

8-15.4 Measurement

Loose riprap will be measured by the ton or per cubic yard of riprap actually placed.

Hand placed riprap will be measured by the cubic yard of riprap actually placed.

Filter blanket will be measured by the ton or cubic yard of filter blanket actually placed.

Sack riprap will be measured by the cubic yard. The number of cubic yards of sack riprap placed shall be computed from the number of sacks of cement actually used in the concrete mix and the yield per batch of concrete as determined by the Engineer from actual predetermined measurement.

Quarry spalls will be measured by the ton or per cubic yard of spalls actually placed.

Channel excavation will be measured by the cubic yard as specified in Section 2-03.

Ditch excavation will be measured by the cubic yard as specified in Section 2-03.

Excavation for toe walls and trenches will be measured by the cubic yard as ditch excavation in accordance with the provisions of Section 2-03.

8-15.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Heavy Loose Riprap”, per ton or per cubic yard.

“Light Loose Riprap”, per ton or per cubic yard.

“Hand Placed Riprap”, per cubic yard.

“Sack Riprap”, per cubic yard.

The unit Contract price per ton or per cubic yard for the class or kind of riprap specified above shall be full pay for furnishing all labor, tools, equipment, and materials required to construct the riprap protection, except for excavation. When it is necessary to dump and sort individual loads, payment will be made only for that portion accepted by the Engineer.

“Quarry Spalls”, per ton or per cubic yard.

The unit Contract price per ton or per cubic yard for “Quarry Spalls” shall be full pay for all costs in furnishing, placing, and compacting spalls.

“Ditch Excavation”, per cubic yard.

“Filter Blanket”, per cubic yard or per ton.

The unit price for “Filter Blanket” shall be full payment for all costs incurred to perform the work in Section 8-15.3(7).

“Channel Excavation”, per cubic yard.

“Channel Excavation Incl. Haul”, per cubic yard.

“Ditch Excavation Incl. Haul”, per cubic yard.

Payment for “Channel Excavation”, “Channel Excavation Incl. Haul”, “Ditch Excavation” and “Ditch Excavation Incl. Haul” is described in Section 2-03.5.

8-16 CONCRETE SLOPE PROTECTION

8-16.1 Description

This Work consists of constructing concrete slope protection, in accordance with these Specifications and the details shown in the Plans, at the locations and in conformity with the lines, grades, and dimensions as staked.

Concrete slope protection shall consist of reinforced cement concrete poured or pneumatically placed upon the slope with a rustication joint pattern or semi-open concrete masonry units placed upon the slope closely adjoining each other.

8-16.2 Materials

Materials shall meet the requirements of the following sections:

Commercial Concrete	6-02.3(2)B
Concrete Slope Protection	9-13.5
Semi-Open Concrete Masonry Units Slope Protection	9-13.5(1)
Poured Portland Cement Concrete Slope Protection	9-13.5(2)
Pneumatically Placed Portland Cement Concrete Slope Protection	9-13.5(3)

8-16.3 Construction Requirements

8-16.3(1) Footing and Preparation of Slope

The footing for the slope protection shall be constructed in accordance with Sections 2-09 and 6-02.

The construction of the footing will be incidental to the slope protection, and no separate measurement or payment will be made.

The surface on which application is to be made shall be thoroughly compacted and neatly trimmed to line and grade as necessary to conform to the detail in the Plans.

8-16.3(2) Placing Semi-Open Concrete Masonry Units

The concrete masonry units shall be placed in a uniform plane and in such a manner that they rest firmly and evenly against the slope with no rocking. The concrete masonry units shall be placed in horizontal parallel courses, and successive courses shall break joints with the preceding course to form a running bond.

8-16.3(3) Poured in Place Cement Concrete

The wire mesh shall lap a minimum of 1 mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall be held so as to provide a minimum of 1¼-inch of cover.

Where commercial concrete is to be placed upon the slope, the method of depositing and compacting shall result in a compact, dense, and impervious concrete which will show a uniform plane surface.

The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown in the Plans.

Curing shall be performed in accordance with Section 5-05.3(13).

8-16.3(4) Pneumatically Placed Concrete

Workers. Only workers experienced in pneumatically placed concrete shall be employed; and satisfactory evidence of such experience shall be furnished when requested by the Engineer.

Equipment. The Contractor shall furnish the Engineer with 2 copies of the manufacturer's Specifications and operating instructions for the equipment used. Before placement of any portion of the slope protection, the type of equipment and method of operation shall be approved by the Engineer.

Proportions of Materials. The sand/cement ratio shall be 4½-parts sand to 1 part cement based on loose dry volume.

Water shall be maintained at a constant pressure that shall be at least 15-PSI above atmospheric pressure at the nozzle. For lengths of hose up to 100-feet, pneumatic pressure at the gun shall be 45-PSI or greater. Pressure shall be increased 5-PSI for each additional 5-feet of hose required. A steady pressure shall be maintained.

Method of Application. Portland cement and sand shall be mixed dry, passed through a cement gun and conveyed by air through a flexible tube, hydrated at a nozzle at the end of the flexible tube, and deposited in place by air pressure.

All surfaces are to be wetted, but application shall not be made on any surface on which free water exists.

Reinforcement. The wire mesh shall lap a minimum of 1 mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall be held so as to provide a minimum of 1¾-inch of cover at the recess.

Finishing. The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown in the Plans.

Curing. Curing shall be in accordance with Section 5-05.3(13).

Protection of Facilities. During the construction, the Contractor shall protect all retaining walls, columns and Structures from concrete splash or overspray. Suitable covering shall be provided if such protection is deemed necessary by the Engineer.

Test Cylinders. Two test cylinders shall be made for each full day's operation. The Contractor shall furnish cylinders 6-inches in diameter and 12-inches high made of ¾-inch mesh hardware cloth. The test cylinder shall be filled with concrete by utilizing the same pneumatic application described above.

The cylinders shall develop a minimum compressive strength of 3,000-PSI at the age of 28-days.

8-16.4 Measurement

Measurement for concrete slope protection will be by the square yard and will include the actual area of the slope covered excluding the footings. The area will be computed on the basis of slope measurements.

8-16.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid item when included in the Proposal:

“Conc. Slope Protection”, per square yard.

8-17 IMPACT ATTENUATOR SYSTEMS

8-17.1 Description

This Work consists of furnishing, constructing, repairing, and removing permanent and temporary impact attenuator systems selected from the approved list shown in the Plans.

8-17.2 Materials

Sand for inertial barrier systems shall not contain more than 5-percent water by weight. Commercial grade urea shall be thoroughly mixed with the sand in an amount equal to 5-percent, by weight, of the sand.

Undamaged sand barrel impact attenuators that have been previously utilized may be utilized in a temporary impact attenuator array only, if inspected and approved by the Engineer prior to use.

8-17.3 Construction Requirements

The assembly and installation of all attenuator systems, except those utilizing sand barrels, shall be supervised at all times by either a manufacturer's representative or an installer who has been trained and certified by the manufacturer of the system. If the supervision is provided by a trained installer, a copy of the installer certification shall be provided to the Engineer prior to installation.

Assembly and installation shall be in accordance with the manufacturer's recommendations. This Work shall include the connection to a concrete barrier, bridge abutment or a transition section identified in the Plans, construction of a steel reinforced concrete pad or concrete backup, and anchorage to the pavement, if required by the manufacturer's assembly and installation procedures.

The Contractor shall have a complete set of replacement parts on the jobsite for each type of temporary impact attenuator in use on the project and shall repair all damaged impact attenuators immediately.

When the Engineer determines that a temporary impact attenuator is no longer needed, then the Contractor shall remove that attenuator from the project. The removed equipment shall remain the property of the Contractor.

8-17.4 Measurement

Temporary and permanent impact attenuators will be measured per each for each installation.

Resetting impact attenuators will be measured per each for each installation that is adjusted or reset to a new location on the project. The Contracting Agency will not measure resetting impact attenuators when it is for the benefit of the Contractor's operations.

8-17.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid items when they are included in the Proposal:

“Temporary Impact Attenuator”, per each.

The unit Contract price for “Temporary Impact Attenuator” shall be full pay for all Work associated with the installation, maintenance, and the final removal of the temporary impact attenuator.

“Permanent Impact Attenuator”, per each.

The unit Contract price for “Permanent Impact Attenuator” shall be full pay for all Work associated with furnishing, installing and all other costs involved with installing the impact attenuator in accordance with the manufacturer’s recommendations.

“Resetting Impact Attenuator”, per each.

The unit Contract price for “Resetting Impact Attenuator” shall be full pay for all Work associated with the removing, transporting, and resetting an impact attenuator.

If an impact attenuator is damaged, it will be repaired in accordance with Section 1-07.13(4) under the Bid item “Reimbursement For Third Party Damage”. No payment will be made for repair of impact attenuators damaged by the Contractor’s operations.

8-18 MAILBOX SUPPORT

8-18.1 Description

This Work consists of removing, maintaining in temporary locations during construction, and reinstalling in permanent locations, all mailboxes affected by Construction work in accordance with the Plans, these Specifications, and the *Standard Plans*.

8-18.2 Materials

Materials shall meet the requirements of the following sections:

Steel Posts	9-32.1
Bracket, Platform, and Anti-Twist Plate	9-32.2
Type 2 Mailbox Support	9-32.7
Timber Sign Posts	9-28.14(1)
Fasteners	9-32.5
Snow Guard	9-32.6
Concrete Base	9-32.8
Steel pipe	9-32.9
U-Channel Post	9-32.10

Mailboxes will be furnished by others.

8-18.3 Construction Requirements

During construction the mailboxes shall be moved to a temporary location where their usefulness will not be impaired. The boxes shall be reinstalled at the original location or at locations determined by the Engineer in accordance with the *Standard Plans*.

The existing mailboxes shall be reinstalled on new mailbox supports, in accordance with the *Standard Plans*, within 24-hours of being removed. The existing mailbox posts shall be removed and disposed of off the project site.

Excavation for new mailbox supports shall be backfilled with adjacent native material and compacted to the satisfaction of the Engineer.

When a newspaper tube is attached to an existing mailbox installation, it shall be removed and attached under the mailbox on the new support, to the satisfaction of the Engineer.

8-18.3(1) Type 3 Mailbox Support

The concrete base shall be constructed using commercial concrete, with the pipe set to the dimensions shown in the *Standard Plans*. The base shall be crowned so as to shed water. The concrete may be mixed on the jobsite as specified in Section 6-02.3(4)B.

The U-channel post may be driven in place provided the method of driving does not damage the post.

With the Engineer's consent, a Type 3 Mailbox Support design, made of steel or other durable material, that meets the NCHRP 350 crash test criteria may be used in place of the design shown in the *Standard Plans*. In which case, the manufacturer's recommendations concerning installation shall be followed; however, the mailbox itself shall be positioned on the Roadway according to the dimensions shown in the *Standard Plans*.

8-18.4 Measurement

Mailbox supports will be measured by the unit for each kind of mailbox support furnished and installed in its permanent location.

8-18.5 Payment

Payment will be made in accordance with Section 1-04.1, for the following Bid item when it is included in the Proposal:

“Mailbox Support, Type _____”, per each.

All costs for the snow guard shall be included in the unit Contract price per mailbox support involved.

8-19 VACANT

8-20 ILLUMINATION, TRAFFIC SIGNAL SYSTEMS, AND ELECTRICAL**8-20.1 Description**

This Work consists of furnishing, installing and field testing all materials and equipment necessary to complete in place, fully functional system(s) of any or all of the following types including modifications to an existing system all in accordance with approved methods, the Plans, the Special Provisions and these Specifications:

1. Traffic Signal System
2. Illumination System
3. Intelligent Transportation Systems

Unless otherwise noted, the location of signals, controllers, standards, and appurtenances shown in the Plans are approximate; and the exact location will be established by the Engineer in the field.

8-20.1(1) Regulations and Code

All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA), Electric Utility Service Equipment Requirements Committee (EUSERC), and California Department of Transportation document entitled Transportation Electrical Equipment Specifications (TEES). Traffic signal control equipment shall conform to the Contract and these Standard Specifications: EIA Electronic Industries Alliance, IEEE Institute of Electrical and Electronics Engineers, the American Society for Testing and Materials (ASTM), the American Association of State Highway and Transportation Officials (AASHTO), the American National Standards Institute (ANSI), whichever is applicable, and to other codes listed herein. In addition to the requirements of these Specifications, the Plans, and the Special Provisions, all material and Work shall conform to the requirements of the National Electrical Code, hereinafter referred to as the Code, and any WACs and local ordinances, which may apply.

Wherever reference is made in these Specifications or in the Special Provisions to the Code, the rules, or the standards mentioned above, the reference shall be construed to mean the code, rule, or standard that is in effect at the date of advertising of the project.

In accordance with RCW 39.06.010, the Contractor need not be registered or licensed if the Contractor has been prequalified as required by RCW 47.28.070.

Safe wiring labels normally required by the Department of Labor and Industries will not be required on electrical Work within the Rights-of-Way of Contracting Agency Highways as allowed in RCW 19.28.141.

Persons performing electrical Work shall be certified in accordance with RCW 19.28.161. Proof of certification shall be supplied to the Engineer prior to the performance of the Work.

8-20.1(2) Industry Codes and Standards

The following electrical industry codes and standard procedures are listed for reference purposes:

Air Movement and Control Association (AMCA), 30 West University Dr. Arlington Heights, Illinois 60004.

American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street N.W., Suite 225, Washington, D.C. 20001.

American National Standards Institute (ANSI), 70 East 45th Street, New York, New York.

American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania.

American Wood Preservers' Association (AWPA), 836 Seventeenth Street, Washington, D.C.

Bell Company Research and Evaluation (Bellcore) 31220 La Brea DR Westlake Village CA 91362.

Edison Electric Institute (EEI), 420 Lexington Avenue, New York, New York.

Electronics Industries Alliance (EIA) 101 Pennsylvania Ave. Washington D. C.

Electric Utility Service Equipment Requirements Committee (EUSERC)

Federal Communications Commission (FCC) 445 12th SW Washington D C 20554.

International Municipal Signal Association (IMSA), P.O. Box 539, 1115 North Main Street, Newark, New York. 14513.

Institute of Electrical and Electronics Engineers (IEEE), 17th Floor, New York, NY 10016

International Telephony Communications Union (ITU) Place des Nations CH 1211 Geneva 20 Switzerland.

Institute of Transportation Engineers (ITE), 2029 K Street, Washington, D.C.20005.

Insulated Power Cable Engineers' Association (IPCEA), 283 Valley Road, Montclair, New Jersey.

National Electrical Manufacturers' Association (NEMA), 155 East 44th Street, New York, New York.

National Fire Protection Association - National Electrical Code (NEC), 470 Atlantic Avenue, Boston, Massachusetts.

National Television Standards Committee (NTSC) 445 12th SW Washington D.C. 20554.

National Transportation Communications for ITS Protocol (NTCIP).

Rural Utilities Service (RUS) 1400 Independence Ave. Washington D C.

Underwriters' Laboratories (UL), 207 East Ohio Street, Chicago, Illinois.

8-20.2 Materials

Materials shall meet the requirements of Section 9-29. Unless otherwise indicated in the Plans or specified in the Special Provisions, all materials shall be new.

Where existing systems are to be modified, the existing material shall be incorporated in the revised system, salvaged, or abandoned as specified in the Contract documents, or as ordered by the Engineer.

8-20.2(1) Equipment List and Drawings

Within twenty-days following execution of the Contract, the Contractor shall submit to the Engineer a completed "Request for Approval of Material" that describes the material proposed for use to fulfill the Plans and Specifications.

If required to do so, the Contractor shall submit supplemental data, sample articles, or both, of the material proposed for use. Supplemental data (6 copies required) would include such items as catalog cuts, product Specifications, shop drawings, wiring diagrams, etc. Any material purchased or labor performed prior to such approval shall be at the Contractor's risk. The Contractor must receive all approvals by the Engineer before materials will be allowed on the job site.

If the luminaries are not listed in the Qualified Products List, the Contractor shall submit 6 copies of the following information for each different type of luminaire required on the Contract:

1. Isocandela diagrams showing vertical light distribution, vertical control limits, and lateral light distribution classification.
2. Details showing the lamp socket positions with respect to lamp and refractor for each light distribution type. This requires that the State know what the light pattern available are and the light distribution.

The Contractor shall submit for approval 6 sets of shop drawings for each of the following types of standards called for on this project:

1. Light standards without pre-approved plans.
2. Signal standards with or without pre-approved plans.

The Contractor will not be required to submit shop drawings for approval for light standards conforming to the pre-approved plans listed in the Special Provisions.

The Engineer's approval of any submitted documentation shall in no way relieve the Contractor from compliance with the safety and performance requirements as specified herein.

Submittals required shall include but not be limited to the following:

1. A material staging plan, should the Contractor propose Contracting Agency-owned property for staging areas.
2. A cable vault installation plan showing the exact proposed installation location by Roadway station, offset and the scheduled sequence for each cable vault installation.
3. A pit plan, for each boring pit, which bears the seal and signature of a licensed professional engineer licensed under title 18 RCW, state of Washington, qualified in civil engineering. The pit plan shall depict the protection of traffic and pedestrians, pit dimensions, shoring, bracing, struts, walers, sheet piles, conduit skids and means of attachment, casing type and casing size.
4. The proposed boring plan which bears the seal and signature of a licensed professional engineer, licensed under title 18 RCW, state of Washington, qualified in civil engineering. The proposed boring plan shall depict the boring system and entire support system.

8-20.3 Construction Requirements

8-20.3(1) General

All workmanship shall be complete and in accordance with the latest accepted standards of the industry.

Existing electrical systems, traffic signal or illumination, or approved temporary replacements, shall be kept in effective operation during the progress of the Work, except when shutdown is permitted to allow for alterations or final removal of the system.

Illumination system shutdowns shall not interfere with the regular lighting schedule, unless permitted by the Engineer. The Contractor shall notify the Engineer prior to performing any Work on existing systems.

Work shall be so scheduled that each electrical system is operational prior to opening the corresponding section of Roadway to traffic.

Traffic signals shall not be placed in operation for use by the public until all required channelization, pavement markings, illumination, signs, and sign lights are substantially complete and operational unless otherwise allowed by the Project Engineer.

The embedded anchors attaching existing electrical, illumination, and traffic signal systems specified for removal to existing concrete Structures shall be removed a minimum of 1-inch beneath the existing concrete surface. The void left by removal of the embedded anchors shall be coated with epoxy bonding agent and filled with mortar

conforming to Section 9-20.4(2). The epoxy bonding agent shall be Type II, conforming to Section 9-26.1, with the grade and class as recommended by the epoxy bonding agent manufacturer and as approved by the Engineer. The mortar shall consist of cement and fine aggregate mixed in the proportions to match the color of the existing concrete surface as near as practicable.

All costs incurred by the Contractor for providing effective operation of existing electrical systems shall be included in the associated electrical Bid items.

8-20.3(2) Excavating and Backfilling

The excavations required for the installation of conduit, foundations, poles and other-accessories shall be performed in a manner that prevents damage to the streets, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical accessories and foundations. Excavating shall not be performed until immediately before installation of conduit and other accessories. The material from the excavation shall be placed where the least interference to vehicular and pedestrian traffic, and to surface drainage, will occur.

All surplus excavated material shall be removed and disposed of by the Contractor in accordance with Section 2-03, or as ordered by the Engineer in accordance with Section 1-04.4.

The excavations shall be backfilled in conformance with the requirements of Section 2-09.3(1)E, Structure Excavation.

At the end of each day's Work and at all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the Roadway open for use by public traffic.

Excavations in the street or Highway shall be performed in such a manner that not more than 1 traffic lane is restricted in either direction at any time unless otherwise approved by the Engineer.

8-20.3(3) Removing and Replacing Improvements

Improvements such as sidewalks, curbs, gutters, Portland cement concrete and hot mix asphalt pavement, bituminous surfacing, base material, and any other improvements removed, broken, or damaged by the Contractor, shall be replaced or reconstructed with the same kind of materials as found on the Work or with other materials satisfactory to the Engineer.

Whenever a part of a square, slab, or section of existing concrete sidewalk, curb, gutter or driveway is broken or damaged, the entire square, slab or section, curb, gutter, driveway shall be removed and the concrete reconstructed as specified above.

The outline of all areas to be removed in Portland cement concrete sidewalks and pavements and hot mix asphalt pavements shall be cut to a minimum depth of 3-inches with a saw prior to removing the sidewalk, driveway, slabs and pavement material. The cut for the remainder of the required depth may be made by a method satisfactory to the Engineer. Cuts shall be neat and true with no shatter outside the removal area.

8-20.3(4) Foundations

Foundation concrete shall conform to the requirements for the specified class, be cast-in-place concrete and be constructed in accordance with Section 6-02.2, and 6-02.3. Concrete for posts, standards, pedestals, and cabinets shall be constructed of concrete Class 3000. Concrete that will fall 5-feet or more shall be placed using an approved tremie, except that a tremie will not be required for placing concrete for a standard 3-foot diameter by 4.5-foot deep luminaire foundation. Steel reinforcing bars for foundations shall conform to Section 9-07.

The bottom of concrete foundations shall rest on firm ground. If the portion of the foundation beneath the existing ground line is formed or cased instead of being cast against the existing soil forming the sides of the excavation, then all gaps between the existing soil and the completed foundation shall be backfilled and compacted in accordance with Section 2-09.3(1)E.

Foundations shall be cast in 1 operation where practicable. The exposed portions shall be formed to present a neat appearance.

The top edges of the luminaire foundation, traffic signal standard foundations, electrical service foundations, traffic signal controller cabinets, Transformer cabinets, ITS Standards, and ITS cabinets shall have a $\frac{3}{4}$ -inch chamfer on the top edge of the foundation. Where 1 or more of the above foundations directly abut each other, no chamfer shall be permitted.

Where soil conditions are poor, the Engineer may order the Contractor to extend the foundations shown in the Plans to provide additional depth. Such additional Work will be paid for according to Section 1-04.4.

When slip bases are installed the conduit, anchor bolts, and other obstructions shall terminate at a height below the elevation of the top of the bottom slip plate. The galvanized surfaces of the slip plates, the keeper plate and the luminaire base plate shall be smooth, without irregularities, to reduce friction and to prevent slacking of bolt tension due to flattening of the irregularities. Slip base luminaire foundations shall have a maximum conduit size of 1-inch.

Forms shall be true to line and grade. Tops of foundations for posts and standards, except special foundations, shall be finished to ground line or sidewalk grade, unless otherwise noted in the Plans.

Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be plumbed and rigidly placed in proper position and to proper height prior to placing concrete and shall be held in place by means of a template until the forms are removed.

Anchor bolts shall be installed so that 2 full threads extend above the top of the top heavy-hex nut, except that slip base anchor bolt extensions shall conform to the specified slip base clearance requirements. Anchor bolts shall be installed plumb, plus or minus 1-degree.

See Standard Specifications Section 8-20.3(9) for additional grounding requirements.

Plumbing of standards shall be accomplished by adjusting leveling nuts. Shims or other similar devices for plumbing or raking will not be permitted except on power installed hot dipped galvanized steel luminaire foundations.

The top heavy-hex nuts of light standards and signal standards shall be tightened in accordance with Section 6-03.3(33), and as follows:

1. The top heavy-hex nuts for all clamping bolts of slip base light standards and Type RM and FB signal standards, shall be tightened using a torque wrench to the torque specified in Sections 8-20.3(13)A and 8-20.3(14)E, respectively.
2. The top heavy-hex nuts for all anchor bolts shall be tightened by the Turn-Of-Nut Tightening Method to minimum rotation of $\frac{1}{4}$ -turn and a maximum rotation of $\frac{1}{3}$ -turn past snug tight. Permanent marks shall be set on the base plate and nuts to indicate nut rotation past snug tight.

Both forms and ground which will be in contact with the concrete shall be thoroughly moistened before placing concrete; however, excess water in the foundation excavation will not be permitted. Foundations shall have set at least 72-hours prior to the removal of the forms. All forms shall be removed, except when the Plans or Special Provisions specifically allow or require the forms or casing to remain.

Class 2 surface finish shall be applied to exposed surfaces of concrete in accordance with the requirements of Section 6-02.3(14)B.

Where obstructions prevent construction of planned foundations, the Contractor shall construct an effective foundation satisfactory to the Engineer.

The combined height of the light standard concrete foundation plus the anchor bolt stub height shall not exceed 4-inches above the ground line.

8-20.3(5) Conduit

Installation of conduit shall conform to appropriate articles of the Code and these Specifications.

The size of conduit used shall be as shown in the Plans. Conduits smaller than 1-inch electrical trade size shall not be used unless otherwise specified, except that grounding conductors at service points may be enclosed in ½-inch-diameter conduit.

Conduit between light standards, PPB, PS, or Type 1 poles and the nearest junction box shall be the diameter specified in the Plans. Larger size conduit is not allowed at these locations. At other locations it shall be the option of the Contractor, at no expense to the Contracting Agency, to use larger size conduit if desired, and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. Reducing couplings will not be permitted.

The ends of all conduits, metallic and nonmetallic, shall be reamed to remove burrs and rough edges. Field cuts shall be made square and true. Slip joints or running threads will not be permitted for coupling metallic conduit; however, running threads will be permitted in traffic signal head spiders and RGS outerduct. When installing rigid galvanized steel conduit and standard coupling cannot be used, an approved three-piece coupling shall be used. Conduit fittings and couplings for steel conduit shall be cleaned first and then painted with one coat of paint conforms to Section 9-08.1(2)B. The paint shall have a minimum wet film thickness of 3-mils. The painted coating shall cover the entire coupling or fitting. The threads on all metallic conduit shall be rust-free, clean, and painted with colloidal copper suspended in a petroleum vehicle before couplings are made. All metallic couplings shall be tightened so that a good electrical connection will be made throughout the entire length of the conduit run. If the conduit has been moved after assembly, it shall be given a final tightening from the ends prior to backfilling. Non-metallic conduit shall be assembled using the solvent cement specified in Section 9-29.1. Where the coating on galvanized conduit has been damaged in handling or installing, such damaged areas shall be thoroughly painted with paint conforming to Section 9-08.1(2)B. Conduit ends shall be capped (do not glue nonmetallic caps). Metallic conduit ends shall be threaded and capped with standard threaded conduit caps until wiring is started. When conduit caps are removed, the threaded ends shall be provided with approved conduit bushings or end bells (do not glue in place) for nonmetallic conduit.

Conduit stubs from controller cabinet foundations shall extend to the nearest junction box in that system.

Metallic conduit bends shall have a radius consistent with the requirements of Article 344.24 and other articles of the Code. Where factory bends are not used, conduit shall be bent, using an approved conduit bending tool employing correctly sized dies, without crimping or flattening, using the longest radius practicable.

Nonmetallic conduit bends, where allowed, shall conform to Article 352.24 of the Code. Eighteen-inch radius elbows shall be used for PVC conduit of 2-inch nominal diameter or less. Standard sweep elbows shall be used for PVC conduit with greater than 2-inch nominal diameter unless otherwise specified in the Plans. In nonmetallic conduit less than 2-inch nominal diameter, pull ropes or flat tapes for wire installation shall be not

less than ¼-inch diameter or width. In nonmetallic conduit of 2-inch nominal diameter or larger, pull ropes or flat tapes for wire installation shall be not less than ½-inch diameter or width.

Conduit shall be laid so that the top of the conduit is a minimum depth of:

1. 24-inches below the bottom of curb in the sidewalk area.
2. 24-inches below the top of the roadway base.
3. 48-inches below the bottom of ties under railroad tracks unless otherwise specified by the railroad company.
4. 24-inches below the finish grade in all other areas.

Rigid galvanized steel conduit shall be installed at the following locations:

1. Within railroad right of way.
2. All pole risers, except when as otherwise required by owning utilities.
3. All surface-mounted conduit, with the exception of electrical service utility poles.
4. All runs within slip form structures.

Couplings in cabinet foundations shall be PVC Schedule 40. The stub-outs above the couplings shall be PVC end bell bushings. The Schedule 40 section of PVC between the coupling and end bell bushing shall be installed without glue.

Conduit runs, without innerduct, installed using the directional boring method, that enter the traveled way or shoulders, shall be Schedule 80 high-density polyethylene (HDPE), Schedule 80 PVC with mechanical couplings, or rigid galvanized steel.

Conduit runs, without innerduct, installed using the directional boring method, that do not enter the traveled way and shoulders, shall be Schedule 40 high-density polyethylene (HDPE), Schedule 40 PVC with mechanical couplings, or rigid galvanized steel.

Multicell conduit runs, installed outside the Traveled Way and Shoulders, when using the directional boring method shall have 4-inch PVC Schedule 40 outerduct with mechanical couplings or 4-inch rigid galvanized steel outerduct. The conduit shall be installed with four 1-inch smooth wall innerducts.

When HDPE conduit is used for directional boring, it shall be continuous, with no joints, for the full length of the bore. The conduit run shall be extended to the associated outlets with the same schedule HDPE or PVC conduit. Entry into associated junction box outlets shall be with the same schedule PVC conduit and elbows. The same requirements apply for extension of an existing HDPE conduit crossing.

PVC conduit and elbows shall be connected to HDPE conduit with an approved mechanical coupling. The connection shall have a minimum pullout strength of 700-pounds. Prior to installation of a mechanical coupling, the HDPE conduit shall first be prepared with a clean, straight edge. A water-based pulling lubricant may be applied to the threaded end of the mechanical coupling before installation. Solvent cement or epoxy shall not be used on the threaded joint when connecting the HDPE conduit to the mechanical coupling. The mechanical coupling shall be rotated until the HDPE conduit seats approximately ¾ of the distance into the threaded coupling depth.

For PVC installation through a directional bore, the PVC shall be in rigid sections assembled to form a watertight bell and spigot-type mechanical joint with a solid retaining ring around the entire circumference of the conduit installed per the manufacturer's recommendations. The conduit run shall be extended beyond the length of the bore, to the associated outlets with the same mechanical coupled PVC or with standard PVC conduit of the same schedule. The same requirements apply for extension of an existing PVC conduit Roadway crossing.

Liquid tight flexible metal conduit is allowed only at locations called for in the Plans.

At all other locations, conduit shall be PVC or rigid galvanized steel and the same type of conduit shall be used for the entire length of the run, from outlet to outlet. Standard PVC conduit shall be connected with medium-grade gray solvent applied per the manufacturer's recommendations.

Where nonmetallic conduit is installed, care shall be used in excavating, installing, and backfilling, so that no rocks, wood, or other foreign material will be left in a position to cause possible damage.

When PVC conduit is installed by a method other than directional boring, conduit shall be Schedule 40, with the exception that PVC conduit within the traveled way or shoulders and service lateral runs shall be Schedule 80.

Metallic and nonmetallic conduit installation shall include equipment grounding conductor and shall conform to requirements noted in the Plans.

Conduit shall be placed under existing pavement by approved directional boring, jacking, or drilling methods at locations approved by the Engineer. The pavement shall not be disturbed unless allowed in the Plans or with the approval of the Engineer in the event obstructions or impenetrable soils are encountered.

Where boring with casing is called for, the casing shall be placed using an auger inside the casing to remove the soil as the casing is jacked forward. The auger head shall proceed no more than 4-inches ahead of the pipe being jacked. Boring operations shall be conducted to prevent caving ahead of the pipe. Installed casing pipe shall be free from grease, dirt, rust, moisture, and any other deleterious contaminants.

The space between the conduit and casing shall be plugged with sandbags and a grout seal 12-inches thick at each end of the casing. Casing abandoned due to an encountered obstruction shall be grout sealed in the same manner. Grout shall conforming to Section 9-20.3(4).

In lieu of sandbags and grout, unopened prepackaged concrete may be used to seal the casing.

Material shall not be removed from the boring pit by washing or sluicing.

All joints shall be welded by a Washington State certified welder. Welding shall conform to AWS D 1.1-80 Structural Welding Code, Section 3, Workmanship.

Directional boring for electrical installations shall be supervised by a licensed electrical contractor in accordance with Section 8-20.1(1). Where directional boring is called for, conduit shall be installed using a surface-launched, steerable drilling tool. Drilling shall be accomplished using a high-pressure fluid jet toolhead. The drilling fluid shall be used to maintain the stability of the tunnel, reduce drag on the conduit, and provide backfill between the conduit and tunnel. A guidance system that measures the depth, lateral position, and roll shall be used to guide the toolhead when creating the pilot hole. Once the pilot hole is established, a reamer and swivel shall be used to install the conduit. Reaming diameter shall not exceed 1.5 times the diameter of the conduit being installed. Conduit that is being pulled into the tunnel shall be installed in such a manner that the conduit is not damaged during installation. The pullback force on the conduit shall be controlled to prevent damage to the conduit. A vacuum spoils extraction system shall be used to remove any excess spoils generated during the installation. Excess drilling fluid and spoils shall be disposed of. The method and location used for disposal of excess drilling fluid and spoils shall be subject to the Engineer's approval. Drilling fluid returns (caused by fracturing of formations) at locations other than the entry and exit points shall be minimized. Any drilling fluid that surfaces through fracturing shall be cleaned up immediately. Mobile spoils-removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing shall be used as necessary during drilling operations.

Bore pits shall be backfilled and compacted in accordance with Section 2-09.3(1)E. Directional boring; and jacking or drilling pits shall be kept 2-feet from the edge of any type of pavement wherever possible. Excessive use of water that might undermine the pavement or soften the Subgrade will not be permitted.

When approved by the Engineer, small test holes may be cut in the pavement to locate obstructions. When the Contractor encounters obstructions or is unable to install conduit because of soil conditions, as determined by the Engineer, additional Work to place the conduit will be paid in accordance with Section 1-04.4.

When open trenching is allowed, trench construction shall conform to the following:

1. The pavement shall be sawcut a minimum of 3-inches deep. The cuts shall be parallel to each other and extend 2-feet beyond the edge of the trench.
2. Pavement shall be removed in an approved manner.
3. Trench depth shall provide 2-feet minimum cover over conduits.
4. Trench width shall be 4-inches or the conduit diameter plus 2-inches, whichever is larger.
5. Trenches located within paved Roadway areas shall be backfilled with Controlled density fill (CDF) meeting the requirements of Section 2-09.3(1)E. The controlled density fill shall be placed level to, and at the bottom of, the existing pavement. The pavement shall be replaced with paving material that matches the existing pavement.

On new construction, conduit shall be placed prior to placement of base course pavement.

Conduit entering through the bottom of a junction box shall be located near the end walls to leave the major portion of the box clear. At all outlets, conduit shall enter from the direction of the run, terminating 6 to 8-inches below the junction box lid and within 3-inches of the box wall nearest its entry location.

Galvanized rigid steel conduit entering cable vaults shall extend 2-inches for the installation of grounded end bushing and bonding. PVC or HDPE conduit entering cable vaults and pull boxes shall terminate flush with the inside walls of the Structure. All conduit ends shall be terminated with termination kits.

Steel conduit entering concrete shall be wrapped in 2-inch-wide pipe wrap tape with a minimum 1-inch overlap for 12-inches on each side of the concrete face. Pipe wrap tape shall be installed per the manufacturer's recommendations.

Innerduct conduit ends shall be terminated with termination kits. Galvanized rigid steel conduit ends shall be terminated with grounded end bushings. PVC conduit ends shall be terminated with end bell bushings.

Fittings shall be installed in accordance with the current electrical codes.

All covered underground conduit shall be cleaned with an approved-sized mandrel and blown out with compressed air prior to pulling wire.

Conduits installed for future use shall be prepared according to this Section. After final assembly is in place, the conduit shall be blown clean with compressed air. Then, in the presence of the Engineer, a cleaning mandrel correctly sized for each size of conduit shall be pulled through to ensure that the conduit has not been deformed. As soon as the mandrel has been pulled through, both ends of the conduit shall be sealed with conduit caps. All conduits scheduled for future use shall originate in a foundation or junction box as detailed in the Plans and terminate in a junction box. All equipment grounding conductors, and the bonding conductor for metallic conduits, shall be bonded in all junction boxes in accordance with Section 8-20.3(9).

Where surface mounting of conduit is required, supports shall consist of channel with clamps sized for the conduit. Support spacing shall comply with the Code, with the exception that spacing of channel supports for conduit shall not exceed 5-feet.

The minimum distance between adjacent clamps and between the clamp and the end of the channel supports shall be 1-inch. Channel supports shall be installed with stops, to prevent clamps from sliding out of the ends. Existing conduit in place scheduled to receive new conductors shall have any existing conductors removed and a cleaning mandrel sized for the conduit shall be pulled through.

All conduits attached to or routed within bridges, retaining walls, and other concrete structures shall be equipped with approved expansion, deflection, and/or combination expansion/deflection fittings at all expansion joints and at all other joints where structure movement is anticipated, including locations where the Contractor, due to construction method, installs expansion and/or construction joints with movement. All conduit fittings shall have movement capacity appropriate for the anticipated movement of the Structure at the joint. Approved deflection fittings shall also be installed at the joint between the bridge end and the retaining wall end, and the transition from bridge, wall, or other concrete structure to the underground section of conduit pipe.

Conduit runs shown in the Plans are for Bidding purposes only and may be changed, with approval of the Engineer, to avoid obstructions.

Where conduit with innerduct is installed, a maximum of 1000-feet of continuous open trench will be allowed unless otherwise approved by the Engineer. All conduit with innerduct exposed above grade level, or on any elevated Structures, or as noted in the Plans, shall be galvanized rigid steel conduit.

Detectable underground warning tape shall be placed 12-inches above all conduit that contains fiber optic cable and all conduits identified to contain future fiber optic cable unless otherwise detailed in the Plans. Detectable underground warning tape shall extend 2-feet into boxes. Splicing shall be per the tape manufacturer's recommended materials and procedures. The warning tape shall be polyethylene with a metallic backing. The polyethylene shall have a minimum 4-mils thickness and be 3-inches wide. The polyethylene shall be orange in color and printed in black with the words conveying the message of Fiber Optic Cable Buried Below.

Location 14 AWG stranded orange USE insulated wire shall be placed in continuous lengths directly above all nonmetallic conduit that contains fiber optic cable and all conduits identified to contain future fiber optic cable unless otherwise detailed in the Plans. Location wire shall extend 8-feet into boxes. Coil and secure location wire at the entrance and exit points of all boxes. Splices shall be crimped using a noninsulated butt splice, soldered and covered with moisture-blocking heat shrink.

After final assembly is in place, all innerducts shall be blown clean with compressed air. Then, in the presence of the Engineer, a cleaning mandrel, correctly sized for the innerduct, shall be pulled through to ensure that the conduit has not been deformed. As soon as the mandrel has been pulled through, a 200-lb. minimum tensile strength pull string shall be installed in each innerduct and attached to duct plugs at both ends of the innerduct.

At all innerduct conduit terminus points, including those in cable vaults and pull boxes, removable and reusable mechanical plugs shall be employed as follows:

1. Outerduct conduits shall be plugged using a quadplex expansion plug inside the conduit around the innerduct.
2. Duct plugs shall be installed in all unused innerducts (those that are specified as empty) at the time of conduit installation.

3. Duct plugs shall be installed in all used innerducts (as specified in the Plans) at the time of conduit installation unless cable pulling for those innerducts will commence within 48-hours.

Innerduct containing one cable shall be plugged using an expandable split plug. Innerducts with multiple cables shall be sealed with self-expanding waterproof foam. The waterproof foam shall not be placed more than 2-inches into the innerduct.

8-20.3(6) Junction Boxes ,Cable Vaults, and Pull boxes

Standard junction boxes, pull boxes and cable vaults shall be installed at the locations shown in the Plans. The Contractor may install, at no expense to the Contracting Agency, such additional boxes as may be desired to facilitate the Work. Junction box installation shall conform to details in the Standard Plans.

Cable vaults and pull boxes shall be installed accordance with the following:

1. Excavation shall be performed in accordance with Section 2-09.
2. Cable vaults and pull boxes shall be installed on 6-inches of crushed surfacing top course, per Section 9-03.9(3), placed on a compacted or undisturbed level foundation.
3. All openings around conduits shall be sealed and filled with grout in accordance with Sections 6-02.3(20), and 9-20.3(4) to prevent water and debris from entering the vaults or pull boxes.
4. Backfilling around the Work shall not be allowed until the concrete or mortar has set.
5. Pull boxes shall be installed in accordance with Plans and details.
6. Pull boxes shall be configured such that the tensile and bending limitations of the fiber optic and other cables are not compromised. Pull boxes shall be configured to mechanically protect the fiber optic and other cables against installation force as well as inert forces after cable pulling operations.
7. Upon acceptance of Work, cable vaults, and pull boxes shall be free of debris and ready for cable installation. All grounding requirements shall be met prior to cable installation.
8. Where installed near steel casings, the pull boxes and cable vaults shall be offset 3-feet, minimum from the centerline of the casing. Factory bends shall be used to route the conduits to the cable vault or pull box.

Adjustments involving raising or lowering the junction boxes shall require conduit modification if the resultant clearance between the top of the conduit and the junction box lid becomes less than 6-inches or more than 10-inches in accordance with the Plans.

Cable vaults and pull boxes shall be adjusted to final grade using risers or rings manufactured by the cable vault and pull box manufacturer. Cable vaults and pull boxes with traffic bearing lids shall be raised to final grade using ring risers to raise the cover only. All voids resulting from the adjustment shall be backfilled with materials matching adjacent surfacing material and compacted in accordance with Section 2-09.3(1)E.

Damage to the junction boxes, pull boxes, cable vaults and the associated conduit system, or wiring resulting from the Contractor's operations, shall be repaired to the Engineer's satisfaction at no additional cost to the Contracting Agency.

Both existing and new junction boxes, pull boxes, and cable vaults shall be adjusted to be flush with the finished grade as well as with the grade during the various construction stages proposed in the Contract.

Where conduit and junction boxes are placed in barrier, the Prime Contractor shall coordinate the Work of the Contractor constructing the barrier and the electrical

Contractor so that each junction box placed in the barrier is placed in correct alignment with respect to the barrier, with the face of the box flush or uniformly chamfered within ½-inch of the barrier surface. If any point on the surface of the junction box placed in barrier is recessed more than ½-inch from the surface of the barrier, the Contractor shall install a box extension meeting the Engineer's approval and grout around the extension or remove and replace the entire section of barrier.

8-20.3(7) Messenger Cable, Fittings

Messenger cable shall be secured to steel strain poles by means of pole bands, and to timber poles by means of single strand guy eye bolts. Pole bands and eyebolts shall be installed as detailed in the Plans.

Messenger cable shall be secured to eye bolts or strain clamps at poles by the use of approved self-locking cable clamp type dead-ending devices. Messenger cable shall be secured to bull rings and anchors by 2 approved U-bolt connectors and guy thimbles.

Traffic signal control cable shall be secured to the messenger cable by cable ties. The ties shall be black nylon with ultraviolet protection and rated at 120-pound minimum unlocking strength.

Down guy assemblies shall be installed as detailed in the Standard Plans.

8-20.3(8) Wiring

All underground wiring shall be installed in conduit unless specifically noted otherwise in the Contract. All wiring in conduit shall be installed with a lubricant recommended by cable/conductor manufacturer.

With the exception of induction loop circuits, magnetometer circuits and illumination circuits, all wiring shall run continuously, without splices, from a terminal located in a cabinet, compartment, pedestrian push button assembly, or signal head to a similarly located terminal. Illumination circuit terminals and traffic circuit signal terminals located below grade will not be allowed. Video detection systems cable installation shall follow manufacturer's Specification, except no below grade terminals will be allowed.

All splices in underground illumination circuits, induction loops circuits, and magnetometer circuits shall be installed in junction boxes. The only splice allowed in induction loop circuits and magnetometer circuits shall be the splice connecting the induction loop lead in conductors or magnetometer lead in conductors to the shielded lead in cable. Splices for induction loop circuits and magnetometer circuits shall be: heat shrink type with moisture blocking, material sized for conductors, epoxy filled clear rigid mold splice kits or rigid re-enterable type splice kits. Conductors for rigid mold kits shall be centered in the splice mold prior to installation of the encapsulation material. Magnetometer and induction loop splices shall be soldered. All connections with #10 and smaller wire shall use copper crimped connectors installed with a positive action (ratchet) tool, except where setscrew connections are allowed for quick disconnects as described in Section 9-29.7. The non-insulated die shall be an indent type and insulated die shall be of a smooth shape capable of crimping pre-insulated terminals and connectors. The tool shall be compound lever type with a ratchet mechanism to ensure positive closure for full crimping cycle. The tool shall be field adjustable to proper calibration with common tools and materials. All connectors installed in splices shall be wrapped with 2 layers of electrical tape. All epoxy splice kits shall be physically separated from other splices and wiring within the junction box to avoid damage from heat during the casting process.

All termination for traffic signal control systems shall follow the conductor sequence color code as shown in the following table.

Conductor Number	Color Code	Color Trace	Use
1	R	Red	Red or Don't Walk
2	O	Orange	Yellow or Spare
3	G	Green	Green or Walk
4	W	White	Neutral
5	B	Black	Ped Call or Spare
6	Wb	White/Black	Neutral or Spare
7	Bl	Blue	Ped Call or Spare
8	Rb	Red/Black	Red or Don't Walk
9	Ob	Orange/Black	Yellow or Spare
10	Gb	Green/Black	Green or Walk

Aerial illumination splices shall employ vice or crimp type pressure connectors. Splice insulation may be epoxy, heat shrink, or tape. Tape splice insulation, where allowed, shall consist of thermoplastic electrical insulating tape equivalent to the original wire insulation rating. It shall be well lapped over the original insulation, and there shall be a coating of moisture resistant varnish applied and allowed to dry. Two layers of friction tape will then be applied, and the splice shall be finished with a second complete coating of moisture resistant varnish.

Quick disconnect connectors shall be installed in the base of all poles supporting a luminaire. Every conductor above ground potential shall be served by a fused quick disconnect kit. Every conductor at ground potential shall be served by an unfused quick disconnect kit.

Pole and bracket cable meeting the requirements of Section 9-29.3(2)D shall be installed between the quick disconnects and the luminaire and between the sign light hand hole and the isolation switch. In addition, the conductors from the isolation switch and the sign light shall be minimum AWG 14, meeting the requirements of Section 9-29.3(2)A or 9-29.3(2)B. Pole and bracket cable jacket shall be removed from the quick disconnect to within 2-inches below the support bracket clamp.

Sufficient slack wire shall be installed at each junction box to allow any conductor, cable, or splice within the junction box to be raised a minimum of 18-inches outside of the box.

Insulated neutral conductors shall be identified in accordance with the NEC requirements. Every conductor at every wire termination, connector, or device shall have an approved, (9-29.13(7)B & C) wire marking sleeve bearing as its legend, the circuit number indicated in the Contract. All terminal strips shall also bear the circuit number consistent with the Contract.

At all illumination circuit splices, each wire entering the splice shall have an approved wire marking sleeve bearing as its legend the circuit number indicated in the Contract.

All wiring, exclusive of the previously mentioned illumination circuits, at junction boxes and at the controller cabinet shall have an approved tag with legends as follows:

1. Individual conductors — the circuit number indicated in the Contract.
2. Multiconductor cable — the numbers of the signal heads and/or pedestrian push buttons served.
3. Loop lead-in cable — the numbers of the loops served.
4. Magnetometer cable — the numbers of the magnetometers served.
5. Camera lead-in cable — The numbers of the phases the camera served.

Drip loops shall be provided on all aerial conductors where they enter poles, signal heads, or weather heads.

When conductors, either cable or single, are being installed, care shall be exercised to not exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand. However, if conductors are pulled by any mechanical means, a dynamometer with drop-needle hand shall be used on every mechanical pull.

On mechanical pulls, insulation shall be stripped off the individual conductor and the conductor formed into a pulling eye and firmly taped, or a cable grip shall be used. The maximum pulling force applied directly to the conductor; i.e., when pulling eyes are used or when the conductor is formed into a loop, shall be limited to that shown in the following table for copper conductor. When a cable grip is applied over nonmetallic sheathed cables, the maximum pulling force shall be limited to 1,000-pounds provided this is not in excess of the force as calculated above.

Conductor	Pounds
8	132
6	210
4	334
3	421
2	531
1	669
1/0	845
2/0	1,065
3/0	1,342
4/0	1,693

To limit the sidewall pressure at bends in duct and conduit runs, the pulling force in pounds shall not exceed 100 times the radius of the bend in feet. Adequate lubrication of the proper type to reduce friction in conduit and duct pulls shall be utilized as necessary. The grease and oil-type lubricants used on lead sheathed cables shall not be used on nonmetallic sheathed cables.

When wiring is noted for future connection, the ends of each wire or cable shall be sealed with an approved heat shrink end cap.

If loop lead splices are not installed immediately after the installation of the loop leads into the adjacent junction box, the ends of the 2 conductor “home run” cable shall be sealed with heat shrink end caps to prevent entry of moisture into the 2 conductor cable. All coaxial cables shall have heat shrink end caps installed prior to aerial or underground installation of the cables to prevent moisture entry into the cable.

Multiconductor cable for signal displays shall be installed entirely through the mounting fitting to a point a minimum of 1-inch inside the signal display housing before the outer insulation is stripped back for the connection of individual conductors to the terminal block.

8-20.3(9) Bonding, Grounding

All metallic appurtenances containing electrical conductors (luminaires, light standards, cabinets, metallic conduit, etc.) shall be made mechanically and electrically secure to form continuous systems that shall be effectively grounded.

Where conduit is installed, the installation shall include an equipment ground conductor, in addition to the conductors noted in the Contract. Bonding jumpers and equipment grounding conductors meeting the requirements of Section 9-29.3(2)A.3 shall be minimum AWG 8, installed in accordance with the NEC. Where existing conduits are used for the installation of new circuits, an equipment grounding conductor shall be installed unless an existing equipment ground conductor, which is appropriate for

the largest circuit, is already present in the existing raceway. The equipment ground conductor between the isolation switch and the sign lighter fixtures shall be a minimum of a 14 AWG stranded copper conductor. Where parallel circuits are enclosed in a common conduit, the equipment-grounding conductor shall be sized by the largest overcurrent device serving any circuit contained within the conduit.

Junction boxes with metallic lids shall have one 4-foot long tinned braided copper equipment bonding strap with full circle connector lugs installed from each metallic junction box lid(s) to the junction box frame. A non-insulated 8 AWG minimum stranded copper conductor, with a full circle crimp on connector (crimped with a manufacturer recommended crimper) shall be connected to the junction box frame or frame bonding stud, the other end shall be crimped to the equipment bonding conductor, using a “C” type crimp connector. The equipment ground conductor shall not be cut or spliced except at junction boxes.

Supplemental grounding shall be provided at light standards, signal standards, cantilever and sign bridge Structures. Steel sign posts which support signs with sign lighting or flashing beacons shall also have supplemental grounding. The supplemental ground conductor shall be connected to the foundation rebar (all rebar crossings shall be wire tied) by means of a grounding connector listed for use in concrete, and lead up directly adjacent to a conduit installed within the foundation. The free end of the conductor shall be terminated to the ground terminal, with an approved clamp, within the pole. If no ground terminal is provided, bond to standard or post. Three-feet of slack shall be provided inside the standard. Where a concrete and rebar foundation is not used the supplemental ground shall be a grounding electrode placed in the hole next to the post prior to back fill. For light standards, signal standards, cantilever and sign bridge Structures the supplemental grounding conductor shall be a non-insulated 4 AWG stranded copper conductor. For steel sign posts which support signs with sign lighting or flashing beacons the supplemental grounding conductor shall be a non-insulated 6 AWG stranded copper conductor.

All connectors between bonding jumpers and equipment grounding conductors shall be installed in accordance with the NEC. Identification of the equipment grounding conductor shall conform to all code requirements.

Bonding of the equipment grounding system and neutral at the service point shall be accomplished as required under the NEC. Grounding of the neutral shall be accomplished only at the service or at a separately derived system.

Two service grounds shall be installed at each electrical service installation and at each separately derived power source. Each service ground shall conform to the detail in the Standard Plans for “Service Ground.” If soil conditions make vertical ground rod installation impossible see NEC as an alternate installation procedure. The service ground installations shall be located a minimum of 6-feet apart. The first service ground rod shall be connected to a continuous grounding electrode conductor running to the service neutral bus. The second service ground rod shall be connected to the same continuous grounding electrode conductor connected to the first ground rod. Ground electrodes shall be bonded copper, ferrous core materials and shall be solid rods not less than 10-feet in length if they are ½-inch in diameter or not less than 8-feet in length if they are ¾-inch or larger in diameter.

The connection of the grounding electrode conductor to the grounding electrode shall be made with 2 approved ground clamps.

Messenger cable shall be bonded to steel strain poles by means of a bond strap connected between an approved U-bolt connector and a bonding lug on the pole.

At points where shields or shielded conductors are grounded, the shields shall be neatly wired and terminated on grounding terminal strip.

8-20.3(10) Services transformer, Intelligent Transportation System Cabinet

Power sources shown in the Plans are approximate only; exact location will be determined in the field.

Aerial fed transformer cabinets and type A, type B, or type C service cabinets shall include a timber pole, as specified in Section 9-29.6(3), a meter base, installed in accordance with serving utility requirements, a 2 or 3 wire service breaker of size noted in the Plans, the necessary conduit risers and ground assembly as noted in the Standard Plan. The timber pole shall be set at a depth of 10-percent of the total pole length plus 2-feet. Modified type B, type D and type E services shall be installed per Contract Plan, and service description in Standard Plans. Pad mounted transformer cabinets shall be installed per Contract Plans.

The service breaker shall be a standard thermal circuit breaker encased in a raintight housing that can be padlocked.

Upon request of the Contractor, the Engineer will make the necessary arrangements with the serving utility to complete the service connections. Electrical energy used prior to Completion of the Contract will be charged to the Contractor, except that the cost of energy used for public benefit, when the Engineer orders such operation, will be borne by the Contracting Agency.

The service, transformer and ITS cabinets shall be marked with the service agreement letters and numbers as noted in the Plans. The markings shall be installed on the outside cabinet door near the top of the cabinet. The markings shall be series C using stencils and black enamel alkyd gloss paint conforming to Federal Specification TT-E-489F.

8-20.3(11) Testing

The Contractor shall conduct the following tests on all electrical circuits with nominal operating voltage between 115-volts and 600-volts, in the presence of the Engineer:

1. Test the continuity of each circuit.
2. Test for grounds in each circuit, which shall consist of the physical examination of the installation to ensure that all required ground jumpers, devices, and appurtenances do exist and are mechanically firm.
3. Using a megohm meter, a 500-volt test on each new circuit between the conductor and ground with all switch boards, panel boards, fuse holders, switches, receptacles, and overcurrent devices in place. All readings shall be recorded. The Contractor shall furnish the Engineer with 3 copies of the test results identifying observed readings with their respective circuits.

The insulation resistance shall not be less than 50-megohms between the conductor and ground on new circuits with a total single conductor length of 2,500-feet and over, nor less than 50 megohms on new circuits with single conductor length of less than 2,500-feet.

Any change in the above stated minimum readings must be approved in writing by the Engineer. Only those factors based on dielectric properties of conductor insulations, splicing insulations, terminal strip castings, etc., will be cause for consideration of a variance.

4. A functional test in which it is demonstrated that each and every part of the system functions as specified.

For those new circuits below 115-volts nominal, except induction loop circuits and test direct burial circuits, the circuits shall be tested with a 500-volt megger for continuity, ground, and a test to demonstrate the circuit functions as specified. The megger test shall show an insulation resistance of not less than 8-megohms to ground.

Any fault in any material or in any part of the installation revealed by these tests shall be replaced or repaired by the Contractor in a manner approved by the Engineer, and the same test shall be repeated until no fault appears.

When the project includes a traffic signal system, the Contractor shall conduct tests noted in Section 8-20.3(14)D. The Contractor shall provide the Engineer a minimum of 5-days advance written notice of the proposed traffic signal turn-on date and time. The traffic signal turn-on procedure shall not begin until all required channelization, pavement markings, illumination, signs, and sign lights are substantially complete and operational unless otherwise allowed by the Engineer. The Contractor shall provide traffic control to stop all traffic from entering the intersection. The Contracting Agency electronics technician will program the controller and enter the timing data, then turn the traffic signal system to its flash mode to verify proper flash indications. The Contracting Agency electronics technician will then conduct functional tests to demonstrate that each part of the traffic signal system, illumination system, or other electrical system, functions as specified. These demonstrations shall be conducted in the presence of a Contracting Agency electronic technician, the Contracting Agency electrical Inspector, and Regional Traffic Engineer or his/her designee. The Contracting Agency electronics technician will then turn the traffic signal to stop and go operation for no less than 1 full cycle. Based on the results of the turn-on, the Engineer will direct the Contracting Agency electronics technician to either turn the traffic signal on to normal stop and go operation, to turn the signal to flash mode for a period not to exceed 5-calendar days, or to turn the signal off and require the Contractor to cover all signal displays and correct all deficiencies.

If the Contractor is directed to turn off the traffic signal, the Contractor shall schedule a new turn-on date with the Engineer in accordance with the previously mentioned procedures.

Unless approved by the Engineer no change to signal stop and go operation will be allowed between 6 AM to 10 AM and 2 PM to 7 PM on Monday through Thursday, nor will signal operation changes be allowed on Friday, weekends, holidays, or the day preceding a holiday.

8-20.3(12) Painting

All painting required shall be done in conformance with applicable portions of Section 6-07.

8-20.3(13) Illumination Systems

8-20.3(13)A Light Standards

Light standards shall be handled when loading, unloading, and erecting in such a manner that they will not be damaged. Any parts that are damaged due to the Contractor's operations shall be repaired or replaced at the Contractor's expense.

Light standards shall not be erected on concrete foundations until foundations have set at least 72-hours or attained a compressive strength of 2,400-PSI, and shall be raked sufficiently to be plumb after all load has been placed.

Slip base installation shall conform to the following:

1. The slip plane shall be free of obstructions such as protruding conduit or anchor bolts. The anchor bolts, and other obstructions shall terminate at a height below the elevation of the top of the slip plate. Conduit shall extend a maximum of 2-inches above the top of the foundation, including grounding end bushing.
2. Washers in the slip plane shall be placed between the slip plate and the keeper plate.

3. Anchor bolts shall extend through the top heavy-hex nut 2 full threads to the extent possible while conforming to the specified slip base clearance requirements. Anchor bolts shall be tightened by the Turn-Of-Nut Tightening Method in accordance with Sections 6-03.3(33) and 8-20.3(4).
4. Clamping bolts shall be tightened in accordance with Sections 6-03.3(33) and 8-20.3(4). The clamping bolts shall be tightened to the specified torque, plus or minus 2-percent, in 2 stages using an accurately calibrated torque wrench before erecting the light standard. Except as otherwise specified, the Contractor shall install 1-inch diameter clamping bolts in all slip bases to a torque of 95-foot-pounds.
5. The galvanized surfaces of the slip plates, the keeper plate and the luminaire base plate shall be smooth, without irregularities, to reduce friction and to prevent slackening of bolt tension due to flattening of the irregularities.
6. Anchor bolts damaged after the foundation concrete is placed shall not be repaired by bending or welding. The Contractor's repair procedure is to be submitted to the Engineer for approval prior to making any repairs. The procedure is to include removing the damaged portion of the anchor bolt, cutting threads on the undamaged portion to remain, the installation of an approved threaded sleeve nut and stud, and repairing the foundation with epoxy concrete. Epoxy concrete shall meet the requirements of Section 9-26.3(1)B.
7. The grout pad shall not extend above the elevation of the bottom of the anchor plate.
8. Wiring for slip base installation shall conform to details in the Standard Plans.

Breakaway coupling installation shall conform to the following:

1. At existing foundations, the anchor nuts, pole, grout pad, and leveling nuts shall be removed. Conduits shall be cut to a maximum height of 2-inches above the foundation including grounding end bushing or bell end. Paint, conforming to Section 9-08.1(2)B, shall be applied to the cut conduit that has been threaded. Anchor bolts that are damaged shall be repaired with approved sleeve nuts as noted under slip base installation procedures.
2. All existing anchor bolts shall be cut off $2\frac{1}{2}$ to 3-inches above the foundation. At new foundations, the anchor bolts shall be installed with top of bolt $2\frac{1}{2}$ to 3-inches above the foundation.
3. Couplings shall be installed to within $\frac{1}{8}$ to $\frac{3}{8}$ -inch of the foundation. Couplings shall then be leveled.
4. The pole shall be set and plumbed; and washers, nuts, and skirt installed per manufacturer's recommendations.
5. The conduit installed in a luminaire foundation shall not exceed 1-inch, trade size.

Slip base insert installations shall conform to details in the Standard Plans, and shall conform to items 1 through 8 above for slip base installation, except that the specified torque for the $\frac{7}{8}$ -inch diameter clamping bolts shall be 50-foot-pounds.

Prior to installation all relocated metal light standards shall have existing painted identification markings removed. Manufacturer's Identification tag shall not be removed. Damaged surfaces and coatings shall be repaired with material matching the existing coating.

All new light standards shall have an approved metal tag riveted to the pole above the handhole. The information provided on the tag shall be as noted on the pre-approved drawings.

All new and relocated metal light standards shall be numbered for identification using painted series C numbers installed 3-feet above the base facing the Traveled Way. Paint shall be black enamel alkyd gloss conforming to Federal Specification TT-E-489. The following information shall be provided as shown in the Plans:

1. Luminaire number.
2. Luminaire wattage.
3. Luminaire voltage.
4. Service number

In setting timber poles, the Contractor shall provide a minimum burial of 10-percent of the total pole length plus 2-feet and shall rake the poles as shown in the Plans.

8-20.3(13)B Vacant

8-20.3(13)C Luminaires

The Contractor shall mark the installation date on the inside of the luminaire ballast housing using a permanent marking pen.

All luminaires shall be mounted level, both transverse and longitudinally, as measured across points specified by the manufacturer. Leveling and orientation shall be accomplished after pole plumbing.

8-20.3(13)D Sign Lighting

Sign illumination equipment shall include fixtures, brackets, conduit, electrical wire, and other material required to make the sign lighting system operable. Sign illumination fixtures shall be fused according to the table in Section 9-29.7.

8-20.3(13)E Sign Lighting Luminaires

The sign lighting luminaire shall be supported by a lighting bracket assembly as detailed in the Plans. If the sign Structure includes a maintenance walkway, the luminaire fixture mounting plate shall be bolted to the walkway grating.

An isolation switch shall be provided in the line side conductors, mounted over the Shoulder to de-energize all luminaires for maintenance purposes. The switch shall be single pole, single throw, or double-pole, single throw as necessary to open all conductors to the luminaires other than neutral and ground conductors. The switch shall contain 600-volt terminal strips on the load side with solderless box lugs as required plus 4 spare lugs per strip. The switch enclosure shall be rated NEMA 3R.

8-20.3(14) Signal Systems

8-20.3(14)A Signal Controllers

All control cabinets and control equipment shall be factory wired ready for operation. Field work will be limited to placing cabinets and equipment and connecting the field wiring to field terminal strips. All controller cabinets shall be installed on a silicone seal pad.

Controllers for portable traffic signal systems shall conform to the requirements of Section 9-29.13(7).

8-20.3(14)B Signal Heads

Unless ordered otherwise by the Engineer, signal heads shall not be installed at any intersection until all other signal equipment is installed and the controller is in place, inspected, and ready for operation at that intersection, except that the signal heads may be mounted if the faces are covered to clearly indicate the signal is not in operation.

Three section displays mounted on type M mounts shall have the plumbizer between the top and second display. Four and 5 section vertical displays mounted on type M mounts shall have the plumbizer between the second and third display.

8-20.3(14)C Induction Loop Vehicle Detectors

Induction loops shall be constructed as detailed in the Contract and the following:

1. Loop wire shall conform to Section 9-29.3.
2. When Type 2 or 6' round (R) loops are grouped at the stop line, the front edge of the first loop shall be 1-foot behind the stop line. Each additional loop installed in the lane shall be on 15-foot centers.
3. Lead-in cable shall conform to Section 9-29.3.
4. All loops shall be installed after grinding or prior to paving the final lift of asphalt designated in the Contract. Loop conductors shall be held at the bottom of the saw cut by high temperature backer rod (sized to fit snugly in the saw cut). Two-inch long pieces of the backer rod shall be installed on 24-inch centers along the entire loop and home run(s) and at the entrance and exit of all turns greater than 45-degrees. If new loops are installed over existing the old loops shall be removed by grinding and the grinding shall be deep enough to destroy any existing operational loop conductors. If not listed as incidental to another item or paid for under another Bid item the additional Work to remove the existing loops shall be paid in accordance with Section 1-04.4.
5. Each loop shall be the size and number of turns indicated in the Plans.
6. No loop installation will be done in rainy weather or when the pavement is wet.
7. All sawcuts shall be cleaned with a high-pressure washer and dried with 100-PSI minimum air pressure, to the satisfaction of the Engineer. If traffic is allowed over the sawcut prior to wire installation, the sawcuts shall be cleaned again.
8. Wiring shall be installed with a blunt-nosed wooden wedge.
9. Prior to the installation of the high temperature backer rod all slack shall be removed from the wiring. Kinks in wiring or folding back of excess wiring will not be allowed.
10. High temperature backer rod, sized for snug fit shall be installed in the saw cut on 2-foot' centers and at all sharp turns.
11. Install sealant as per Contract or as approved by the Engineer.
12. Sealant shall be applied such that air bubbles or foam will not be trapped in the sawcut.

8-20.3(14)D Test for Induction Loops and Lead-in Cable

All tests shall be performed by the Contractor in the presence of the Engineer for each loop. The tests shall be performed at the amplifier location after complete installation of the loop. All costs associated with testing shall be included in the unit Contract prices of the respective Bid items.

Test A — The DC resistance between the 2 lead-in cable wires will be measured by a volt ohmmeter. The resistance shall not exceed 10-ohms.

Test B — A megohm meter test at 500-volts DC shall be made between the lead-in cable shield and grounding, prior to connection to grounding. The resistance shall equal or exceed 100-megohms.

Test C — A megger test shall be made between the loop circuit and grounding. The resistance shall equal or exceed 100-megohms.

Test D — An inductance test to determine the inductance level of each inductance loop. The Contractor shall record the inductance level of each inductance loop installed on the project and shall furnish the findings to the Engineer. An inductance level below 150-microhenries is considered a failure for a Type 1 loop, any 1 round loop and an inductance level below 75-microhenries is considered a failure for a Type 2 loop.

If any of the installations fails to pass all tests, the loop installation or lead-in cable shall be repaired and replaced and then retested.

8-20.3(14)E Signal Standards

Traffic signal standards shall be furnished and installed in accordance with the methods and materials noted in the Contract and the following:

1. All dimensions and orientations will be field verified by the Engineer prior to fabrication.
2. The signal standard component identification shall conform to details in the Plans.
3. Disconnect connectors complete with pole and bracket cable shall be installed in any signal standard supporting a luminaire. Illumination wiring installation shall conform to details in the Plans for slip base wiring.
4. No field drilling will be allowed on signal mast arms except for the installation of any required pre-empt indicators, pre-empt detectors, microwave detector, or type "N" signal mountings. The maximum diameter shall be 1-inch.
5. All pole entrances required for pole-mounted signal heads, cabinets, signs, pedestrian push button assemblies, etc., shall be field drilled.
6. Damage to the galvanized pole surface resulting from field drilling shall be repaired with approved zinc rich paint.
7. Field welding will not be allowed, except as shown in the Plans.
8. All tenons shall be factory installed.
9. All welding shall be completed prior to galvanizing.
10. Foundations shall be constructed to provide the pole orientation noted in the Plans. Anchor bolts shall be tightened in accordance with Sections 6-03.3(33) and 8-20.3(4).
11. Slip base installation for Type RM and FB signal standards shall conform to the slip base installation requirements specified in Section 8-20.3(13)A, except that the specified torque for the 3/4-inch diameter clamping bolts shall be 50 foot-pounds.
12. The pole shall be plumbed after signal heads are installed.
13. The space between the bottom base plate and the top of foundation shall be filled with grout with a 3/8-inch plastic drain tube.

Signal standards shall not be erected on concrete foundations until the foundations have attained 2400-PSI or 14-days after concrete placement. Signal standards without mast arms may be erected after 72-hours. Type IV and V strain pole standards may be erected but the messenger cable (span wire) shall not be placed until the foundation has attained 2400-PSI or 14-days after concrete placement.

Signal supports used with portable traffic signal systems shall provide a minimum of 2 signal displays, spaced a minimum of 8-feet apart.

When portable traffic signals are used to provide alternating one-way control, a minimum of 1 of the signal displays shall be suspended over the Traveled Way. The minimum vertical clearance to the Traveled Way for this signal display is 16-feet 6-inches.

Timber strain poles shall be set a burial depth of 10-percent of the total length plus 2-feet and shall be raked as noted in the Plans.

8-20.3(15) Grout

Grout shall conform to the requirements of Section 6-02.3(20) and 9-20.3(4).

8-20.3(16) Reinstalling Salvaged Material

When the Contract requires salvaged electrical equipment to be reinstalled, the Contractor shall furnish and install all necessary materials and equipment, including anchor bolts, nuts, washers, concrete, etc., required to install the salvaged equipment.

8-20.3(17) “As Built” Plans

Upon Physical Completion of the Work, the Contractor shall submit corrected shop drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected Plans to show the Work as constructed.

These drawings shall be on sheets conforming in size to the provisions of Section 1-05.3.

8-20.4 Measurement

No specific unit of measurement will apply to the lump sum items for illumination, intelligent transportation, or traffic signal systems, but measurement will be for the sum total of all items for a complete system to be furnished and installed.

Conduit of the kind and diameter specified will be measured by the linear foot for the actual neat line length in place, unless the conduit is included in an illumination system, signal system, Intelligent Transportation (ITS) or other type of electrical system lump sum Bid item.

Casing – will be measured by the linear foot for the actual length of casing placed, unless the casing is included in an illumination, signal or other electrical system lump sum Bid item.

Directional boring will be measured by the linear foot for the length of the boring tunnel.

8-20.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Illumination System _____”, lump sum.

“Traffic Signal System _____”, lump sum.

“Intelligent Transportation System _____”, lump sum.

The lump sum Contract price for “Illumination System, _____”, “Traffic Signal System _____”, “Intelligent Transportation System _____”, shall be full pay for the construction of the complete electrical system, modifying existing systems, or both, including sign lighting systems, as described above and as shown in the Plans, and herein specified, including excavation, backfilling, concrete foundations, conduit, wiring, restoring facilities destroyed or damaged during construction, salvaging existing materials, and for making all required tests. All additional materials and labor, not shown in the Plans or called for herein and which are required to complete the electrical system, shall be included in the lump sum Contract price.

“Conduit Pipe _____ In. Diam.”, per linear foot.

The unit Contract price per linear foot for “Conduit _____ In. Diam.” shall be full pay for furnishing all pipe, pipe connections, elbows, bends, caps, reducers, conduits, and unions; for placing the pipe in accordance with the above provisions, including all excavation, jacking or drilling required, backfilling of any voids around casing, conduits, pits or the trenches, restoration of native vegetation disturbed by the operation, chipping of pavement, and bedding of the pipe; and all other Work necessary for the construction of the conduit, except that when conduit is included on any project as an integral part of an illumination, traffic signal, or ITS systems and the conduit is not shown as a pay item, it shall be included in the lump sum price for the system shown.

All costs for installing conduit containing both signal and illumination wiring shall be included in the Contract prices for the signal system.

All costs for installing junction boxes containing both illumination and signal wiring shall be included in the Contract prices for the signal system.

“Casing”, per linear foot.

The unit Contract price per linear feet for “casing” shall be full payment for boring, jacking or drilling for installing casing, and backfilling any voids around the casing and pits or back filling of the trenches required to install the casing. This cost will also include any restoration of native vegetation disturbed by the operation.

“Directional Boring”, per linear foot

The unit Contract price per linear foot for “Directional Boring”, shall be full pay for furnishing all labor, materials, equipment and electrical supervision associated with the directional boring.

8-21 PERMANENT SIGNING

8-21.1 Description

This Work consists of furnishing and installing permanent signing, sign removal, sign relocation, and refacing existing signs in accordance with the Plans, these Specifications, and the Plans at the locations shown in the Plans or where designated by the Engineer.

8-21.2 Materials

Signing materials and fabrication of signs shall meet the requirements of Section 9-28. Materials for roadside sign Structures shall meet the requirements of Section 9-06.16. Materials for sign mounting shall conform to Section 9-28.11. Materials for sign bridges, cantilever sign Structures, and bridge mounted sign brackets shall conform to Section 9-28.14(2).

8-21.3 Construction Requirements

8-21.3(1) Location of Signs

Signs are located in the Plans by station numbers. These are tentative locations subject to change by the Engineer. The post lengths specified in the Plans are estimated for Bid purposes only. Final lengths of timber posts will be determined or verified by the Engineer at the request of the Contractor prior to fabrication. Final lengths of steel posts will be determined by the Engineer prior to fabrication.

8-21.3(2) Placement of Signs

All reflectorized signs located less than 30-feet from the edge of the lane should be turned out approximately 3-degrees from the pavement edge of oncoming traffic lanes, and those located 30-feet or more from the edge of the lane should be turned in approximately 3-degrees from the pavement edge of oncoming traffic lanes. All sign posts shall be plumb and signs level. The signs shall be inspected at night by the Engineer and, if specular glare occurs from failure to install at 3-degrees as stipulated, the Contractor shall reinstall the signs at no expense to the Contracting Agency. The post holes shall be of sufficient dimensions to allow placement and thorough compaction of selected backfill material completely around the post. Selected backfill material shall consist of earth or fine sandy gravel free from organic matter with no individual particles exceeding 1½-inches in diameter.

8-21.3(3) Sign Covering

When notified by the Engineer, the Contractor shall cover or uncover certain signs to facilitate and control the operation of the project. The covering shall consist of 4-mils minimum thickness black polyethylene sheeting of sufficient size to entirely cover the sign, unless otherwise approved by the Engineer, and shall extend over the edges of the sign and fastened on the back. The Contractor shall not use any type of adhesive tape on the face of the signs. Other methods of covering may be considered if approved by the Engineer.

8-21.3(4) Sign Removal

Where shown in the Plans or ordered by the Engineer, the existing signs and, if so indicated, the sign Structures shall be removed by the Contractor.

Sign Structures shall include sign bridges, cantilever sign Structures, bridge-mounted sign brackets, and any other sign-mounting Structure shown in the Plans to be removed by the Contractor.

The embedded anchors attaching signs and sign Structures specified for removal to existing concrete Structures shall be removed a minimum of 1-inch beneath the

existing concrete surface. The void left by removal of the embedded anchors shall be coated with epoxy bonding agent and filled with mortar conforming to Section 9-20.4(2). The epoxy bonding agent shall be Type II, conforming to Section 9-26.1, with the grade and class as recommended by the epoxy bonding agent manufacturer and as approved by the Engineer. The mortar shall consist of cement and fine aggregate mixed in the proportions to match the color of the existing concrete surface as near as practicable.

Where indicated, the Contractor shall remove concrete pedestals to a minimum of 2-feet below Subgrade or finished ground elevation and backfill the hole to the satisfaction of the Engineer. Where an existing sign post is located within a sidewalk area, the Contractor shall remove the post and finish the area so as to make the sidewalk continuous. Aluminum signs, wood signs, wood sign posts, wood Structures, metal sign posts, windbeams, and other metal structural members shall become the property of the Contractor and shall be removed from the project. Salvage value of the removed signs and sign Structure members shall be reflected in the Contractor's Bid price for other items of Work.

8-21.3(5) Sign Relocation

Where shown in the Plans, the existing signs and, if so indicated, the sign Structures shall be relocated by the Contractor to the location noted. Where the existing sign Structure is mounted on concrete pedestals, the Contractor shall remove the pedestal to a minimum of 12-inches below finished grade and backfill the remaining hole with material similar to that surrounding the hole. Where the existing Structure is to be relocated, the Contractor shall provide necessary materials, labor, and hardware, and if so indicated, electrical conduit, conductors, etc., electrical services, and connections so as to erect and provide an operable unit to the satisfaction of the Engineer. All materials damaged by the Contractor shall be replaced at no cost to the Contracting Agency. Unless otherwise allowed, relocation of each existing sign and Structure shall be accomplished during the day in which it was removed. Relocation of overhead signs and Structures shall be accomplished during the hours between 12 midnight and 4:00 a.m. or as approved by the Engineer.

8-21.3(6) Sign Refacing

Where indicated in the Plans or in the Special Provisions, the Contractor shall reface existing signs with sheet aluminum overlay panels. Unless otherwise indicated in the Plans or allowed by the Engineer, all Work shall be accomplished while the existing sign is in place. Modifications to each sign shall be completed during the same day in which the Work is commenced.

Prior to the installation of overlay panels, the existing legend (message and border) shall be removed. The aluminum overlay panels shall be butt jointed. Aluminum or stainless steel screws, a minimum of ½-inch in length, shall be used to attach overlay panels to existing plywood signs. In addition to the screws, two ¼-inch diameter by 1-inch-long aluminum or stainless steel bolts shall be installed through the top of each panel and the plywood sign. Aluminum blind rivets shall be used to attach overlay panels to existing aluminum signs. Screws or rivets shall be installed at 24-inch centers. Unless otherwise noted, sign background material shall be in accordance with Section 9-28.

After installation of overlay panels, the existing legend shall be reinstalled or, where indicated in the Plans, new legend or portions thereof shall be furnished and installed by the Contractor. Direct applied legend shall be applied to the new face prior to resurfacing. Layout and letter spacing shall be in accordance with Contracting Agency standards unless otherwise approved by the Engineer. New legend components shall be of the same type and size as the existing materials, and it shall be the Contractor's responsibility to verify material type and size. Materials damaged by the Contractor shall be replaced at no expense to the Contracting Agency.

8-21.3(7) Sign Message Revision

Where indicated in the Plans or in the Special Provisions, the Contractor shall revise existing sign messages or layouts. The Contractor shall remove and reinstall portions of or all of the existing message or furnish and install new message components as necessary to provide the revised message as indicated. Prior to installing the revised message, the Contractor shall thoroughly clean the sign face and plug all existing rivet holes with aluminum blind rivets painted the same color as the sign background. Plugging screw holes in plywood signs will not be required. Modifications to the sign shall be completed during the same day in which Work is commenced and while the sign is in place. All new materials necessary to accomplish this Work shall be the same type and size as the existing components, and it shall be the Contractor's responsibility to verify such component type and size. Materials damaged by the Contractor shall be replaced at no expense to the Contracting Agency. Existing materials not reinstalled shall become the property of the Contractor and shall be removed from the project.

8-21.3(8) Sign Cleaning

Signs shall be cleaned after relocation or installation to the satisfaction of the Engineer. The Contractor shall not use cleaning solvents that would be harmful to the sign finish.

8-21.3(9) Sign Structures**8-21.3(9)A Fabrication of Steel Structures**

Fabrication and erection shall conform to the applicable requirements of Section 6-03 and 9-06. All welded connections of sign bridge and cantilever sign Structure posts, arms, and beams, including base and connection plates, shall be cleaned prior to welding to remove all mill scale from within 2-inches of the weld. As an alternative to the blast cleaning requirements of Section 6-03.3(13), the Contractor may perform the cleaning using power hand tools as approved by the Engineer. Unless otherwise specified in the Plans or Special Provisions, metal surfaces shall not be painted.

8-21.3(9)B Vacant**8-21.3(9)C Timber Posts**

Timber sign posts shall conform to the requirements of Section 9-28.14(1).

8-21.3(9)D Aluminum Structures

Welding of aluminum shall be in accordance with Section 9-28.14(3).

8-21.3(9)E Bridge Mounted Sign Brackets

The Contractor shall fabricate and install sign supports for mounting signs on bridge Structures at the locations and as shown in the Plans, including inserts and anchor bolts. Fabrication and installation shall be in accordance with applicable requirements of Sections 6-03 and 9-06. Metal surfaces shall not be painted.

The quantity of structural carbon steel shown in the Contract is listed only for the convenience of the Contractor in determining the volume of Work involved and is not guaranteed to be accurate. The prospective Bidders shall verify this quantity before submitting a Bid. No adjustments other than for approved changes will be made in the lump sum Contract price for the bridge mounted sign brackets, even though the actual quantity of structural carbon steel required may deviate from that listed.

8-21.3(9)F Foundations

The excavation and backfill shall conform to the requirements of Section 2-09.3(1)E. Where obstructions prevent construction of planned foundations, the Contractor shall construct an effective foundation satisfactory to the Engineer.

The bottom of concrete foundations shall rest on firm ground. If the portion of the foundation beneath the existing ground line is formed or cased instead of being cast against the existing soil forming the sides of the excavation, then all gaps between the existing soil and the completed foundation shall be backfilled and compacted in accordance with Section 2-09.3(1)E.

Foundations shall be cast in one operation where practicable. The exposed portions shall be formed to present a neat appearance. Class 2 surface finish shall be applied to exposed surfaces of concrete in accordance with the requirements of Section 6-02.3(14)B.

Where soil conditions are poor, the Engineer may order the Contractor to extend the foundations shown in the Plans to provide additional depth. Such additional work shall be paid for according to Section 1-04.4.

Forms shall be true to line and grade. Tops of foundations for roadside sign structures shall be finished to ground line unless otherwise shown in the Plans or directed by the Engineer. Tops of foundations for sign bridges and cantilever sign structures shall be finished to the elevation shown in the Plans.

Both forms and ground that will be in contact with the concrete shall be thoroughly moistened before placing concrete; however, excess water in the foundation excavation will not be permitted. Forms shall not be removed until the concrete has set at least 3-days. All forms shall be removed, except when the Plans or Special Provisions specifically allow or require the forms or casing to remain.

Foundation concrete shall conform to the requirements for the specified class, be cast-in-place concrete, and be constructed in accordance with Section 6-02.2 and 6-02.3.

Sign structures shall not be erected on concrete foundations until foundations have attained a compressive strength of 2,400-psi.

In addition to the basic requirements, sign bridges and cantilever sign structures shall be installed in accordance with the following:

1. Tops of foundations for sign bridges and cantilever sign structures shall be finished to the elevation shown in the Plans.
2. Steel reinforcing bars shall conform to Section 9-07.
3. Concrete shall be Class 4000, except as otherwise specified. Where water is present in the shaft excavations for Type 1 foundations for sign bridges and cantilever sign structures, the shaft concrete shall be Class 4000P placed in accordance with Section 6-02.3(6)B.
4. All bolts and anchor bolts shall be installed so that two full threads extend beyond the top of the top heavy-hex nut. Anchor bolts shall be installed plumb, plus or minus 1-degree.
5. Plumbing of sign bridges and cantilever sign structures shall be accomplished by adjusting leveling nuts. Shims or other similar devices for plumbing or raking will not be permitted.
6. The top heavy-hex nuts of sign bridges and cantilever sign structures shall be tightened in accordance with Section 6-03.3(33), and by the Turn-Of-Nut Method to a minimum rotation of $\frac{1}{4}$ turn and a maximum of $\frac{1}{3}$ turn past snug tight. Permanent marks shall be set on the base plate and nuts to indicate nut rotation past snug tight.

In addition to the basic requirements, roadside sign structures shall be installed in accordance with the following:

1. Tops of foundations shall be finished to final ground line unless otherwise shown in the Plans or staked by the Engineer.
2. Spiral reinforcing shall conform to AASHTO M32. All other steel reinforcement shall conform to the requirements of Section 9-07.
3. Concrete shall be commercial grade concrete.
4. The assembly and installation of all Type TP-A or Type TP-B bases for roadside sign structures shall be supervised at all times by either a manufacturer's representative or an installer who has been trained and certified by the manufacturer of the system. If the supervision is provided by a trained installer, a copy of the installer's certification shall be provided to the Engineer prior to installation.
5. For all Type TP-A or TP-B bases, the Contractor shall attach four female anchors to a flat rigid template following the manufacturer's recommendations. The Contractor shall lower the anchor assembly into fresh concrete foundation and vibrate into position such that the tops of the anchor washers are flush with the finished top surface of the foundation. The Contractor shall support the template such that all anchors are level and in their proper position.

Slip base and hinge connection nuts of roadside sign structures shall be tightened using a torque wrench to the torque, following the procedure specified in the Plans.

8-21.3(9)G Identification Plates

When sign Structures are removed, the Contractor shall remove the sign Structure identification plates from the sign Structures and give them to the Engineer.

8-21.3(10) Sign Attachment

Sign panels consisting of sheet aluminum or fiberglass reinforced plastic shall be attached or mounted to signposts or sign structures as shown in the Plans.

Signs not conforming to the above, including all variable message sign (VMS) assemblies and other message boardtype assemblies, shall be attached or mounted to signposts or sign structures by means of positive connections—defined as through-bolted connections. The use of clips or clamps to accomplish the attachment or mounting of such signs and assemblies is prohibited.

8-21.3(11) Multiple Panel Signs

After installation of multiple panel signs, the Contractor shall furnish and install an approved reinforced aluminized tape on the reverse side of the sign to prevent visible light through the seam. The tape shall be pressure sensitive and a minimum of 2-inches wide and 2 mils thick. In lieu of tape, the Contractor may use 1-inch-wide aluminum sheeting riveted to the sign back. The aluminum shall be a minimum of 0.032-inch thick. Rivet heads shall match the sign face color.

8-21.3(12) Steel Sign Posts

For roadside sign structures on Type TP-A or Type TP-B bases, the Contractor shall use the following procedures and manufacturer's recommendations:

1. The couplings, special bolts, bracket bolts, and hinge connection nuts on all Type TP-A or Type TP-B bases shall be tightened using the Turn-Of-Nut Tightening Method to a maximum rotation of $\frac{1}{2}$ turn past snug tight.
2. The Contractor shall shim as necessary to plumb the steel signposts.

For roadside sign structures on all Type PL and SB slip bases, the Contractor shall use the following procedures:

1. The Contractor shall assemble the steel signpost to stub post with bolts and flat washers as shown in the Plans.
2. Each bolt shall be tightened using a torque wrench to the torque, following the procedures specified in the Plans.

8-21.4 Measurement

When shown as lump sum in the Plans or in the Proposal as permanent signing, sign bridge No. ____, cantilever sign Structure No. ____ or bridge mounted sign bracket No. ____, no specific unit of measurement will apply, but measurement will be for the sum total of all items to be furnished and installed.

Sign covering will be measured in square feet of the area of the sign covered.

8-21.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

"Permanent Signing", lump sum.

"Sign Bridge No. ____", lump sum.

"Cantilever Sign Structure No. ____", lump sum.

"Bridge Mounted Sign Bracket No. ____", lump sum.

"Sign Covering", per square foot.

8-22 PAVEMENT MARKING

8-22.1 Description

This Work consists of furnishing, installing, and removing pavement markings upon the Roadway surface in accordance with the Plans, Standard Plans, the FHWA publication Standard Alphabet for Highway Signs and Pavement Markings and these Specifications, at locations shown in the Contract or as ordered by the Engineer in accordance with Section 1-04.4.

Pavement Markings may be either Longitudinal (long) Line Markings or Transverse Markings. Longitudinal line markings are generally placed parallel and adjacent to the flow of traffic. Transverse markings are generally placed perpendicular and across the flow of traffic. Word and symbol markings are classified as transverse markings. Traffic letters used in word messages shall be 8-feet high with the exception of the “R” in the railroad crossing symbol which shall be as shown in the Standard Plans.

8-22.2 Materials

Material for pavement marking shall be paint or plastic as noted in the Bid item meeting the requirements of Section 9-34. Glass beads for paint shall meet the requirements of Section 9-34.4. Glass beads for plastic shall be as recommended by the material manufacturer.

8-22.3 Construction Requirements

8-22.3(1) Preliminary Spotting

The Engineer will provide necessary control points at intervals agreed upon with the Contractor to assist in preliminary spotting of the lines before marking begins. The Contractor shall be responsible for preliminary spotting of the lines to be marked. Approval by the Engineer is required before marking begins. Preliminary spotting to guide the striping machine is required for all longitudinal lines except where a clearly visible separation is present. Preliminary spotting shall be provided at a spacing of 100-feet maximum on tangents and 25-feet maximum on curves. The color of the material used for spotting shall match the color of the permanent marking.

8-22.3(2) Preparation of Roadway Surfaces

All surfaces shall be dry, free of any loose debris, and within the proper temperature range prior to striping. When required by the pavement marking manufacturer's installation instructions, remove pavement markings from pavement surfaces that will adversely affect the bond of new pavement marking material to the roadway surface according to Section 8-22.3(6).

Remove all other contaminants from pavement surfaces that may adversely affect the installation of new pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the pavement with a high-pressure system to remove extraneous or loose material.

Apply materials to new HMA that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D material applied to new HMA pavement requires a pavement cure period of 21-days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.

For new Portland cement concrete surfaces, remove curing compounds and laitance by an approved mechanical means. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to concrete that has reached a minimum compressive strength of 2,500-psi and that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D material applied to Portland cement concrete pavement requires a pavement cure period of 28-days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.

After the pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

8-22.3(3) Marking Application

8-22.3(3)A Marking Colors

Lane line and right edge line shall be white in color. Centerline and left edge line shall be yellow in color. Transverse markings shall be white, except as otherwise noted in the Standard Plans.

8-22.3(3)B Line Patterns

Solid line – A continuous line without gaps.

Broken line – A line consisting of solid line segments separated by gaps.

Dotted line – A broken line with noticeably shorter line segments separated by noticeably shorter gaps.

8-22.3(3)C Line Surfaces

Flat lines – Pavement marking lines with a flat surface.

Profiled marking – A profiled pavement marking is a marking that consists of a base line thickness and a profiled thickness, which is a portion of the pavement marking line that is applied at a greater thickness than the base line thickness. Profiles shall be applied using the extruded method in the same application as the base line. The profiles may be slightly rounded provided the minimum profile thickness is the same throughout the length of the profile. See the Plans for the construction details.

Embossed plastic line – Embossed plastic lines consist of a flat line with transverse grooves. An embossed plastic line may also have profiles. See the Plans for the construction details.

8-22.3(3)D Line Applications

Surface line – A line constructed by applying pavement marking material directly to the pavement surface or existing pavement marking.

Grooved line – A line constructed by grinding or saw cutting a groove into the pavement surface and spraying, extruding, or gluing pavement marking material into the groove. Groove depth is measured vertically from the bottom of a 2-foot or longer straight edge placed on the roadway surface to the ground surface. The groove depth is dependent upon the material used, the pavement surface, and the location. See these Standard Specifications, the project Plans, and Special Provisions.

8-22.3(3)E Installation

Apply pavement marking materials to clean, dry pavement surfaces and according to the following:

1. Place material according to the manufacture's recommendations;
2. Place parallel double lines in one pass;
3. The top of pavement marking shall be smooth and uniform;
4. Line ends shall be square and clean;
5. Place pavement marking lines parallel and true to line; and,
6. Place markings in proper alignment with existing markings.

When applying paint, Type A or Type C material, ensure that both the pavement surface and the air temperature at the time of application are not less than 50°F and rising. When applying Type B or Type D material, ensure that both the pavement surface and the air temperature at the time of application are not less than 40°F and rising.

Ensure that the Type A thermoplastic material meets the manufacturer's temperature specifications when it contacts the pavement surface.

Two applications of paint will be required to complete all paint markings. The second application of paint shall be squarely on top of the first pass. The time period between paint applications will vary depending on the type of pavement and paint (low VOC waterborne, high VOC solvent, or low VOC solvent) as follows:

Pavement Type	Paint Type	Time Period
Bituminous Surface Treatment	Low VOC Waterborne	4-hours min., 48-hours max.
Hot Mix Asphalt Pavement	Low VOC Waterborne	4-hours min., 30-days max.
Cement Concrete Pavement	Low VOC Waterborne	4-hours min., 30-days max.
Bituminous Surface Treatment	High and Low VOC Solvent	40-min. min., 48-hrs. max.
Hot Mix Asphalt Pavement	High and Low VOC Solvent	40-min. min., 30-days max.
Cement Concrete Pavement	High and Low VOC Solvent	40-min. min., 30-days max.

Centerlines on 2-lane Highways with broken line patterns, paint, or plastic shall be applied in the increasing milepost direction so they are in cycle with existing broken line patterns at the beginning of the project. Broken line patterns applied to multilane or divided Roadways shall be applied in cycle in the direction of travel.

Where paint is applied on centerline on two-way roads with bituminous surface treatment or centerline rumble strips, the second paint application shall be applied in the opposite (decreasing milepost) direction as the first application (increasing milepost) direction. This will require minor broken line pattern corrections for curves on the second application.

8-22.3(3)F Application Thickness

Pavement markings shall be applied at the following base line thickness measured above the pavement surface or above the groove bottom for grooved markings in thousandths of an inch (mils):

Marking Material Application		HMA	PCC	BST	Groove
Depth					
Paint – first coat	spray	10	10	10	
Paint – second coat	spray	15	15	15	
Type A – flat/transverse & symbols	extruded	125	125	125	
Type A – flat/long line & symbols	spray	90	90	120	
Type A – with profiles	extruded	90	90	120	
Type A – embossed	extruded	160	160	160	
Type A – embossed with profiles	extruded	160	160	160	
Type A – grooved/flat/long line	extruded	230	230	230	250
Type B – flat/transverse & symbols	heat fused	125	125	125	
Type C-2 – flat/transverse & symbols	adhesive	90	90	NA	
Type C-1 & 2 – flat/long line	adhesive	60	60	NA	
Type C-1 – grooved/flat/long line	adhesive	60	60	NA	100
Type D – flat/transverse & symbols	spray	120	120	120	
Type D – flat/transverse & symbols	extruded	120	120	120	
Type D – flat/long line	spray	90	90	120	
Type D – flat/long line	extruded	90	90	120	
Type D – profiled/long line	extruded	90	90	120	
Type D – grooved/flat/long line	extruded	230	230	230	250

Liquid pavement marking material yield per gallon depending on thickness shall not exceed the following:

Mils thickness	Feet of 4" line/gallon	Square feet/gallon
10	483	161
15	322	108
18	268	89
20	242	80
22	220	73
24	202	67
30	161	54
40	122	41
45	107	36
60	81	27
90	54	18
90 with profiles	30	10
120	40	13
120 with profiles	26	9
230	21	7

Solid pavement marking material (Type A) yield per 50-pound bag shall not exceed the following:

Mils thickness	Feet of 4" line/50# bag	Square feet/50# bag
30 – flat	358	120
45 – flat	240	80
60 – flat	179	60
90 – flat	120	40
90 – flat with profiles	67	23
120 – flat	90	30
120 – flat with profiles	58	20
125 – embossed	86	29
125 – embossed with profiles	58	20
230 – flat grooved	47	15

All grooved lines shall be applied into a groove cut or ground into the pavement. For Type A or Type D material, the groove shall be cut or ground with equipment to produce a smooth square groove 4-inches wide. For Type C-1 material, the groove shall be cut with equipment to produce a smooth bottom square groove with a width in accordance with the material manufacturer's recommendation. After grinding, clean the groove by shot-blasting or a method approved by Engineer. Immediately before placing the marking material, clean the groove with high-pressure air.

8-22.3(3)G Glass beads

Top dress glass beads shall be applied to all spray and extruded pavement marking material. Glass beads shall be applied by a bead dispenser immediately following the pavement marking material application. Glass bead dispensers shall apply the glass beads in a manner such that the beads appear uniform on the entire pavement marking surface with 50 to 60-percent embedment. Hand casting of beads will not be allowed.

Glass beads shall be applied to 10 or 15 mil thick paint at a minimum application rate of 7-pounds per gallon of paint. For plastic pavement markings, glass bead type and application rate shall be as recommended by the marking material manufacturer.

When 2 or more spray applications are required to meet thickness requirements for Type A and Type D materials, top dressing with glass beads is only allowed on the last application. The cure period between successive applications shall be in accordance with the manufacturer's recommendations. Any loose beads, dirt or other debris shall be swept or blown off the line prior to application of each successive application. Successive applications shall be applied squarely on top of the preceding application.

8-22.3(4) Tolerances for Lines

Allowable tolerances for lines are as follows:

Length of line – The longitudinal accumulative error within a 40-foot length of broken line shall not exceed plus or minus 1-inch. The broken line segment shall not be less than 10-feet.

Width of line – The width of the line shall not be less than the specified line width or greater than the specified line width plus ¼-inch.

Lane width – The lane width, which is defined as the lateral width from the edge of pavement to the center of the lane line or between the centers of successive lane lines, shall not vary from the widths shown in the Contract by more than plus or minus 4-inches.

Thickness – A thickness tolerance not exceeding plus 10-percent will be allowed for thickness or yield in paint and plastic material application.

Parallel lines – The gap tolerance between parallel lines is plus or minus ½-inch.

8-22.3(5) Installation Instructions

Installation instructions for plastic markings shall be provided for the Engineer. The instructions shall include equipment requirements, approved work methods and procedures, material application temperature range, air and pavement surface temperature requirements, weather limitations, precautions, and all other requirements for successful application and material performance. Do not use materials with incomplete or missing instructions. All materials including glass beads shall be installed according to the manufacturer's recommendations. A manufacturer's technical representative shall be present at the initial installation of plastic material to approve the installation procedure or the material manufacturer shall certify that the Contractor will install the plastic material in accordance with their recommended procedure.

8-22.3(6) Removal of Pavement Markings

Pavement markings to be removed shall be obliterated until blemishes caused by the pavement marking removal conform to the coloration of the adjacent pavement. If, in the opinion of the Engineer, the pavement is materially damaged by pavement marking removal, such damage shall be repaired by the Contractor in accordance with Section 1-07.13(1). Sand or other material deposited on the pavement as a result of removing lines and markings shall be removed as the Work progresses to avoid hazardous conditions. Accumulation of sand or other material which might interfere with drainage will not be permitted.

8-22.4 Measurement

Center line, center line with no pass line, double center line, double lane line, edge line, solid lane line, dotted extension line, lane line, reversible lane line, and two-way left turn center line will be measured by the completed linear foot as "Paint Line", "Plastic Line", "Embossed Plastic Line", "Profiled Plastic Line", "Profiled Embossed Plastic Line" or "Grooved Plastic Line".

The measurement for "Paint Line" will be based on a marking system capable of simultaneous application of three 4-inch lines with two 4-inch spaces. No deduction will be made for the unmarked area when the marking includes a broken line such as center line, dotted extension line, center line with no-pass line, lane line, reversible lane line, or two-way left turn center line. No additional measurement will be made when more than 1 line can be installed on a single pass such as center line with no-pass line, double center line, double lane line, reversible lane line, or two-way left turn center line.

The measurement for "Plastic Line", "Embossed Plastic Line", "Profiled Plastic Line", "Profiled Embossed Plastic Line" or "Grooved Plastic Line" will be based on the total length of each 4-inch wide plastic line installed. No deduction will be made for the unmarked area when the marking includes a broken line such as, center line, dotted extension line, center line with no-pass line, lane line, reversible lane line, or two-way left turn center line.

The measurement for "Painted Wide Lane Line", "Plastic Wide Lane Line", "Profiled Plastic Wide Lane Line", "Painted Wide Line", "Plastic Wide Line", "Painted Barrier Center Line", "Plastic Barrier Center Line", "Painted Stop Line", or "Plastic Stop Line", will be based on the total length of each painted, plastic or profiled plastic line installed. No deduction will be made for the unmarked area when the marking includes a broken line such as, wide broken lane line, drop lane line, or wide dotted lane line. The measurement for double wide lane line will be based on the total length of each wide lane line installed.

No additional measurement for payment will be made for the required second application of paint. No additional measurement for payment will be made for additional applications required to meet thickness requirements for plastic markings.

Diagonal and chevron-shaped lines used to delineate medians, gore areas, and parking stalls are constructed of painted or plastic 4-inch or 8-inch lines in the color and pattern shown in the Standard Plans. These lines will be measured as "Painted Line", "Plastic Line", "Painted Wide Line" or "Plastic Wide Line" by the linear foot of line installed. Crosswalk line will be measured by the square foot of marking installed.

Traffic arrows, traffic letters, access parking space symbols, HOV symbols, railroad crossing symbols, drainage markings, bicycle lane symbols, aerial surveillance full, and ½ markers, yield line symbols, yield ahead symbols, and speed bump symbols will be measured per each. Type 1 through 6 traffic arrows will be measured as 1 unit each, regardless of the number of arrow heads.

Removal of lines, 4-inches, 8-inches, 18-inches and 20-inches in width will be measured by the linear foot, with no deduction being made for the unmarked area when the marking includes a gap.

Removal of traffic arrows, traffic letters, access parking space symbol, HOV lane symbol, railroad crossing symbol, bicycle lane symbols, drainage markings, aerial surveillance full and ½ markers, yield line symbol, yield ahead symbol, and speed bump symbol will be measured per each. Removal of crosswalk lines will be measured by the square foot of lines removed.

8-22.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

- "Paint Line", per linear foot.
- "Plastic Line", per linear foot.
- "Embossed Plastic Line", per linear foot.
- "Profiled Plastic Line", per linear foot.
- "Profiled Embossed Plastic Line", per linear foot.
- "Grooved Plastic Line", per linear foot.
- "Painted Wide Lane Line", per linear foot.
- "Plastic Wide Lane Line", per linear foot.
- "Profiled Plastic Wide Lane Line", per linear foot.
- "Painted Wide Line", per linear foot.
- "Plastic Wide Line", per linear foot.
- "Painted Barrier Center Line", per linear foot.
- "Plastic Barrier Center Line", per linear foot.
- "Painted Stop Line", per linear foot.
- "Plastic Stop Line", per linear foot.
- "Painted Crosswalk Line", per square foot.
- "Plastic Crosswalk Line", per square foot.
- "Painted Traffic Arrow", per each.
- "Plastic Traffic Arrow", per each.
- "Painted Traffic Letter", per each.
- "Plastic Traffic Letter", per each.

- “Painted Access Parking Space Symbol”, per each.
- “Plastic Access Parking Space Symbol”, per each.
- “Painted Railroad Crossing Symbol”, per each.
- “Plastic Railroad Crossing Symbol”, per each.
- “Painted Bicycle Lane Symbol”, per each.
- “Plastic Bicycle Lane Symbol”, per each.
- “Painted Drainage Marking”, per each.
- “Plastic Drainage Marking”, per each.
- “Painted Aerial Surveillance Full Marker”, per each.
- “Plastic Aerial Surveillance Full Marker”, per each.
- “Painted Aerial Surveillance ½ Marker”, per each.
- “Plastic Aerial Surveillance ½ Marker”, per each.
- “Painted Access Parking Space Symbol with Background”, per each.
- “Plastic Access Parking Space Symbol with Background”, per each.
- “Painted HOV Lane Symbol”, per each.
- “Plastic HOV Lane Symbol”, per each.
- “Painted Yield Line Symbol”, per each.
- “Plastic Yield Line Symbol”, per each.
- “Painted Yield Ahead Symbol”, per each.
- “Plastic Yield Ahead Symbol”, per each.
- “Painted Speed Bump Symbol”, per each.
- “Plastic Speed Bump Symbol”, per each.
- “Removing Paint Line”, per linear foot.
- “Removing Plastic Line”, per linear foot.
- “Removing Painted Crosswalk Line”, per square foot.
- “Removing Plastic Crosswalk Line”, per square foot.
- “Removing Painted Traffic Marking”, per each.
- “Removing Plastic Traffic Marking”, per each.

8-23 TEMPORARY PAVEMENT MARKINGS

8-23.1 Description

The Work consists of furnishing and installing temporary pavement markings. Temporary pavement markings shall be provided where noted in the Plans and for all lane shifts and detours resulting from construction activities. Temporary pavement markings shall also be provided when permanent markings are eliminated because of construction operations. Temporary pavement markings shall be maintained in serviceable condition throughout the project until permanent pavement markings are installed. Temporary pavement markings that are damaged shall be repaired or replaced immediately. Temporary painted center lines, edge lines, or lane lines and temporary raised pavement markers that are, in the opinion of the Engineer, damaged due to normal wear by traffic, shall be replaced. Any temporary line marked with tape shall be repaired immediately when it no longer provides the intended use.

Temporary pavement marking installations are defined as follows:

Temporary Center Line

A BROKEN line used to delineate adjacent lanes of traffic moving in opposite directions. The broken pattern shall be based on a 40-foot unit, consisting of a 4-foot line with a 36-foot gap if paint or tape is used. If temporary raised pavement markers are used, the pattern shall be based on a 40-foot unit, consisting of a grouping of 3 temporary raised pavement markers, each spaced 3-feet apart, with a 34-foot gap.

Temporary Edge Line

A SOLID line used on the edges of Traveled Way. The line shall be continuous if paint or tape is used. If temporary raised pavement markers are used, the line shall consist of markers installed continuously at 5-foot spacings.

Temporary Lane Line

A BROKEN line used to delineate adjacent lanes with traffic traveling in the same direction. The broken pattern shall be based on a 40-foot unit, consisting of a 4-foot line with a 36-foot gap, if paint or tape is used. If temporary raised pavement markers are used, the pattern shall be based on a 40-foot unit, consisting of a grouping of 3 temporary raised pavement markers, each spaced 3-feet apart, with a 34-foot gap.

Lane line and right edge line shall be white in color. Center line and left edge line shall be yellow in color. Edge Lines shall be installed only if specifically required in the Contract. All temporary pavement markings shall be retroreflective.

8-23.2 Materials

Materials for temporary markings shall be paint, tape, or raised pavement markers and selected from approved materials listed in the Qualified Products List.

8-23.3 Construction Requirements

8-23.3(1) Preliminary Spotting and Removal

All preliminary layout and marking in preparation for application and the application and removal of temporary pavement markings shall be the responsibility of the Contractor.

Temporary flexible raised pavement markers are required for bituminous surface treatment operations.

Temporary pavement markings consisting of paint or tape may be paved over, but temporary raised pavement markers or removable tape shall be removed prior to paving.

Any temporary pavement markings that are required on the wearing course prior to construction of permanent pavement markings and are not a part of the permanent

markings shall be completely removed concurrent with or immediately subsequent to the construction of the permanent pavement markings. Temporary flexible raised pavement markers on bituminous surface treatment pavements shall be cut off flush with the surface if their location conflicts with the alignment of the permanent pavement markings.

All damage to the permanent Work caused by removing temporary pavement markings shall be repaired by the Contractor at no additional cost to the Contracting Agency.

8-23.3(2) Marking Application

8-23.3(2)A Temporary Pavement Marking Paint

Paint used for temporary pavement markings shall be applied in one application at a thickness of 15-mils or 108-square feet per gallon. Glass beads shall be in accordance with Section 8-22.3(3)G.

8-23.3(2)B Temporary Pavement Marking Tape

Surface preparation and application of temporary pavement marking tape shall be in conformance with the manufacturer's recommendations.

8-23.3(2)C Temporary Raised Pavement Markers

Surface preparation and application of temporary flexible raised pavement markers shall be in conformance with the manufacturer's recommendations. When temporary flexible raised pavement markers are used for bituminous surface treatment operations, the markers shall be installed with the protective cover in place. The cover shall be removed after spraying asphaltic material.

Application of temporary raised pavement markers (other than temporary flexible raised pavement markers) shall conform to the requirements of Section 8-09.3.

8-23.3(2)D Tolerance for Lines

Tolerance for lines shall conform to Section 8-22.3(4).

8-23.4 Measurement

Temporary center line, temporary edge line, temporary lane line, and temporary raised pavement markers will be measured by the linear foot of each installed line or grouping of markers, with no deduction for gaps in the line or markers.

Reinstalled paint markings and raised pavement markers, when ordered by the Engineer due to normal wear by traffic, will be measured again, each time ordered. Repair, for any reason, of temporary markings made with tape shall not be measured.

Removing temporary center line, temporary edge line, temporary lane line, and temporary raised pavement markers will be measured by the linear foot of each line or grouping of markers removed, with no deduction for gaps in the line or markers.

8-23.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

"Temporary Pavement Marking," per linear foot.

The unit Contract price per linear foot for "Temporary Pavement Marking" shall be full pay for constructing and maintaining temporary lines and markers as specified. Unless a Bid item has been included in the Proposal to pay for removal of temporary pavement markings, all costs for removal of temporary pavement markings shall be included in the unit Contract price per linear foot for "Temporary Pavement Marking." No additional compensation will be allowed when the Contractor is required to repair temporary taped markings that have been damaged or worn.

"Removing Temporary Pavement Marking," per linear foot.

8-24 ROCK AND GRAVITY BLOCK WALL AND GABION CRIBBING**8-24.1 Description**

This Work consists of constructing rock and gravity block wall(s), and gabion cribbing in accordance with the Plans, Special Provisions, these Specifications, or as designated by the Engineer.

8-24.2 Materials

Materials shall meet the requirements of the following Sections:

Rock for Rock Wall and Chinking Material	9-13.7(1)
Backfill for Rock Wall	9-13.7(2)
Gabion Cribbing	9-27.3
Wire Mesh Fabric	9-27.3(1)
PVC Coating for Welded Wire Mesh Fabric	9-27.3(2)
Gabion Basket Fasteners	9-27.3(4)
Stone	9-27.3(6)
Construction Geotextile	9-33

Materials for gravity block walls shall be as specified in the Special Provisions.

8-24.3 Construction Requirements**8-24.3(1) Rock Wall****8-24.3(1)A Geometric Tolerances**

The completed wall shall meet the following tolerances:

1. Wall batter shall be 6:1 or flatter as specified in the Plans.
2. The exterior slope plane and grade in the finished surface of the wall shall be plus or minus 6-inches.
3. The maximum void between adjacent rocks shall be 6-inches as measured at the smallest dimensions of the void within the thickness of the wall.

8-24.3(1)B Excavation

Excavation shall conform to Section 2-09.3(4), and to the limits and construction stages shown in the Plans.

The Contractor shall restrict the excavation limits to the length of rock wall that can be constructed in 1-day's Work, except as otherwise noted. The Engineer may permit excavation beyond the limits that can be completed in 1-day's Work provided the Contractor either demonstrates that the excavation will remain stable until the rock wall is completed, or shores the excavation in accordance with Section 2-09.3(4).

Slope above the rock wall shall be established prior to excavating for the wall.

8-24.3(1)C Foundation Preparation

The foundation for the wall shall be graded as shown in the Plans.

Prior to rock placement, the foundation, if not in rock, shall be compacted as approved by the Engineer. Any foundation soils found to be unsuitable shall be removed and replaced in accordance with Section 2-09.3(1)C.

Base course rocks shall have full contact with the foundation soils. If necessary, the excavation shall be shaped to fit the rocks. Rocks may be dropped to shape the ground provided the rocks do not crack. Cracked rocks shall be replaced and the foundation reggraded to fit the replacement rock.

8-24.3(1)D Construction Geotextile

Construction geotextile shall be of the type, and shall be placed, as shown in the Plans.

8-24.3(1)E Rock Placement and Backfill

Rocks shall be placed so there are no continuous joint planes in either the vertical or lateral direction.

Where possible, rocks shall be placed so that the rock shall bear on at least 2 rocks below it. Rocks shall be oriented so that flat surface contact points between adjacent rocks are maximized. Point-to-point contact between adjacent rocks shall be minimized. Each rock in a course shall be arranged so that the natural irregularities in the rocks key the rocks together and so that the courses are keyed together.

Rocks shall increase in size from the top of the wall to the bottom at a uniform rate. The minimum rock sizes, as referenced from the top of the wall, shall be as follows:

Depth from Top of Wall (feet)	Minimum Rock Size at Depth from Top of Wall
6	Three Man
9	Four Man
12	Five Man

Rocks at the top of the wall shall be Two Man or larger.

Where voids larger than 6-inches are present, chinking rock shall be keyed between the rocks to fill the void.

Backfill for the rock wall shall be placed behind each course and tamped to provide a stable condition prior to placing rocks for the next successive course.

For rock walls constructed in fills, the fill shall be overbuilt and cut back to construct the wall.

8-24.3(2) Gravity Block Wall

Excavation shall conform to Section 2-09.3(4), and to the limits and construction stages shown in the Plans. Foundation soils found to be unsuitable shall be removed and replaced in accordance with Section 2-09.3(1)C. Slope above the gravity block wall shall be established prior to beginning any excavation for the wall.

Gravity block walls are defined as a wall of modular blocks acting as a gravity wall to retain soil. The modular blocks may have features designed to interlock the blocks together. However there shall be no reinforcement of the retained soil nor any reinforcement connection between the modular blocks and the retained soil.

Gravity block walls shall be constructed as specified in the Special Provisions and as shown in the Plans.

8-24.3(3) Gabion Cribbing**8-24.3(3)A Foundations**

Before placing any gabion cribbing, the Contractor shall excavate the foundation or bed to the specified grade in accordance with Section 2-09.3(4). Foundation soils found to be unsuitable shall be removed and replaced in accordance with Section 2-09.3(1)C.

8-24.3(3)B Baskets

Baskets may be fabricated from either woven or welded steel wire; however, a gabion Structure shall not include both. Baskets may be assembled with either lacing wire or clip fasteners; however, a perimeter or diaphragm edge shall not include both.

8-24.3(3)C Dimensions

The Contractor shall supply gabion baskets in the lengths and heights the Plans require. Each length shall be a multiple (double, triple, or greater) of horizontal width. Horizontal width shall be 36-inches. All baskets from the same manufacturer shall be the same width and shall be within a tolerance of 5-percent of the manufacturer's stated sizes.

8-24.3(3)D Fabrication of Baskets

Gabions shall be made so that the sides, ends, lid, and diaphragms can be assembled into rectangular baskets of the required sizes at the construction site. Common-wall construction may be used in gabion Structures up to 12-feet high. Common-wall construction includes any basket where its top serves as the bottom of the 1 above it, or where 1 wall also serves an adjacent basket. When gabion Structures are more than 12-feet high, the baskets shall have independent sides, ends, top, and bottom.

Each gabion shall be divided by diaphragms into cells the same length as horizontal basket width. Diaphragms shall be made of the same mesh and gage as the basket body.

All perimeter and diaphragm edges shall be laced or clipped together so that joints are at least as strong as the body of the mesh itself. The ends of the lacing shall be anchored by 3 tight turns around the selva wire.

8-24.3(3)E Filling Baskets

Baskets shall be filled with stone. The stone shall be placed and compacted to meet the unit weight requirements of Section 8-24.3(3)F.

The stone shall be placed in compacted layers not more than 14-inches deep. If cross-connecting wires are required, the Contractor shall adjust the number and depth of layers so that wires occur between the compacted layers of stone.

8-24.3(3)F Unit Weight Requirements and Test

The unit weight of the filled gabion basket shall be at least 100-pounds per cubic foot. Should the unit weight be less than 100-pounds per cubic foot, the gabion will be rejected and the Engineer will require the Contractor to conduct and pass additional unit weight tests before completing other gabions.

The Contractor shall conduct either of the following unit weight tests to prove the density of completed gabions:

1. A filled gabion basket shall be selected from the completed Structure and weighed.
2. A gabion basket shall be filled with stone from a loaded truck that has been weighed. After filling, the truck and unused stone shall be weighed again. The difference between the 2 weights shall be used to determine the weight per cubic foot of the stone in the gabion.

The Contractor shall conduct 1 unit weight test for each 500 cubic yards of gabions placed. The Engineer may reduce the specified frequency of these tests provided the specified minimum unit weight has been consistently achieved.

In conducting unit weight test 1 or 2, the Contractor shall provide and use scales conforming to Section 1-09.2.

8-24.3(3)G Gabion Cribbing Erection

Each row or tier of baskets shall be reasonably straight and shall conform to alignment and grade. Hexagonal mesh baskets shall be stretched endwise before filling. The stone shall be carefully placed in layers, then tamped or vibrated. The last layer of stones shall fill each basket completely so that the secured lid will rest upon the stones. Each basket shall be laced securely to all adjacent baskets and its lid then laced or clipped to the sides, ends, and diaphragms.

All selva wires of ends of adjacent baskets shall be laced together. The bottom selva of the basket being constructed on a previously constructed basket shall be laced to the top of that basket.

Backfilling behind or around gabions shall conform to Section 2-09.3(1)E.

8-24.4 Measurement

Rock for rock walls and backfill for rock walls will be measured by the ton of rock actually placed.

Gabion cribbing will be measured by the calculated neat line volume of gabion baskets in place, using the manufacturer's stated dimensions.

Gravity block wall will be measured by the square foot of completed wall in place. The vertical limits for measurement are from the bottom of the bottom layer of blocks to the top of the top layer of blocks. The horizontal limits for measurement are from the end of wall to the end of wall.

Construction geotextile will be measured by the square yard for the surface area actually covered.

Structure excavation Class B, Structure excavation Class B including haul, and shoring or extra excavation Class B, will be measured in accordance with Section 2-09.4.

8-24.5 Payment

Payment will be made in accordance with Section 1-04.1 for each of the following Bid items that are included in the Proposal:

"Rock for Rock Wall", per ton.

The unit Contract price per ton for "Rock for Rock Wall" shall also include furnishing and installing chinking materials.

"Backfill for Rock Wall", per ton.

"Gabion Cribbing", per cubic yard.

"Gravity Block Wall", per square foot.

"Construction Geotextile", per square yard.

"Structure Excavation Class B", per cubic yard.

"Structure Excavation Class B Incl. Haul", per cubic yard.

"Shoring or Extra Excavation Class B", per square foot.

8-25 GLARE SCREEN

8-25.1 Description

This Work consists of furnishing and constructing glare screen of the types specified, in accordance with the Plans, these Specifications, the Standard Plans, and as ordered by the Engineer in accordance with Section 1-04.4.

Glare screen consists of diamond woven wire mesh fence of aluminum, galvanized or aluminum coated steel wire, fabricated and placed to reduce glare from headlights of opposing traffic or other adjacent light sources.

8-25.2 Materials

Materials shall meet the requirements of Section 9-16.6.

8-25.3 Construction Requirements

8-25.3(1) Glare Screen Fabric

Glare screen fabric shall be placed on the face of the posts designated by the Engineer. On curves, the fabric shall be placed on the face of the post that is on the outside of the curve.

The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, corner, and pull posts shall be with stretcher bars and fabric bands spaced at 1-foot intervals. The fabric shall be cut and each span attached independently at all pull and corner posts. Fabric shall be securely fastened to line and brace posts with tie wires, metal bands, or other approved methods, attached at 14-inch intervals. The top and bottom of the fabric shall be fastened to the tension cable and tension wire with hog rings spaced at 24-inch intervals.

Rolls of wire fabric shall be joined by weaving a single strand into the end of the rolls to form a continuous mesh.

8-25.3(2) Slats

The slats shall be fastened into the weave by using staples, screws, or other methods as approved by the Engineer. Allowing the tension of the mesh to hold the slats in place will not be permitted.

Slats broken or split during construction shall be removed and replaced by the Contractor at no expense to the Contracting Agency.

8-25.3(3) Posts

Posts, other than for Type 1 Design A, shall be constructed in accordance with the Standard Plans and applicable provisions of Section 8-12.3(1)A.

Posts for Type 1 Design A shall be bolted to the beam guardrail posts as detailed in the Standard Plans. Drilling of the guardrail posts shall be done in such a manner to ensure that the glare screen posts are set plumb and centered over the guardrail posts unless otherwise directed.

All round posts for Type 1 Design B and Type 2 glare screen shall be fitted with a watertight top securely fastened to the post. Line posts shall have tops designed to carry the top cable.

8-25.3(4) Tension Wire

Tension wires shall be attached to the posts as detailed in the Standard Plans or as approved by the Engineer.

8-25.3(5) Tension Cables

Fasten the tension cables after the posts have been installed and those set in concrete have sufficiently cured.

The tension cable shall pass through the line post top, and 1 continuous length of cable shall be used between the pull posts. Sufficient tension shall be applied to the cable to allow a maximum sag of ¼-inch between posts after the chain link mesh has been attached to the cable. The Contractor shall provide temporary bracing on pull posts when applying tension to 1 length of cable at a time to prevent undue stresses on the pull post.

The cable shall be fastened to the top of the pull post with an eye bolt through the post and a turnbuckle connecting the eye bolt to the cable. The top of the pull posts shall be braced diagonally to the bottom of the end, corner, or brace posts with a short length of cable as shown in the Plans. All turnbuckles shall have a minimum of 1-inch take-up clearance after tensioning.

The ends of all cables shall be seized with annealed iron wire for a distance of at least 1-inch.

Attach U-bolt wire rope clips to the cable ends by placing the base (saddle) of the clip against the live end of the cable, while the “U” of the bolt presses against the dead end. Two clips shall be used per end, spaced a minimum of 6-cable diameters apart with a wire rope thimble placed securely in the loop eye to prevent kinking.

8-25.3(6) Fittings, Attachments and Hardware

A galvanized iron strap ¼-inch in thickness by 2-inches in width, formed as shown in the Plans, shall be provided for the attachment of eye bolts and eye nuts to the base and top of the H column posts in order to take the strain of the cable tension off the web of the H column. The straps are required between any tension cable fitting and the H column, one per side, unless the screen post is mounted to a guardrail post. Then a strap is only required on the outside (nut side) face. The straps are only required at tension cable attachment locations.

8-25.4 Measurement

Measurement of glare screen will be by the linear foot of completed glare screen for the particular type and design specified.

8-25.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Glare Screen Type 1 Design _____”, per linear foot.

“Glare Screen Type 2”, per linear foot.

8-26 VACANT

8-27 VACANT

8-28 VACANT

8-29 WIRE MESH SLOPE PROTECTION

8-29.1 Description

This Work consists of constructing wire mesh slope protection in accordance with these Specifications and the details shown in the Standard Plans and in conformity with the lines and dimensions shown in the Plans or established by the Engineer.

8-29.2 Materials

Materials shall meet the requirements of Section 9-16.4.

8-29.3 Construction Requirements

8-29.3(1) Anchors

The Contractor shall install anchors of the type shown in conformance to the layout shown in the Plans. The spacing and number of the anchors and wire ropes as shown in the Plans are approximate only, and the Engineer will arrange the spacing in such a manner as to hold the wire mesh against the slope. Backfill material shall be thoroughly compacted.

8-29.3(2) Wire Rope Assembly

The wire rope assembly shall be in place before the wire mesh is attached. The bottom wire rope shall not be tensioned. No wire rope splicing will be allowed.

8-29.3(3) Wire Mesh

The wire mesh shall be fastened to the completed wire rope assembly as shown in the Plans. Hog rings on the vertical lap splices shall be placed in a single row centered on the splice. Horizontal splices joining 2 rolls of mesh shall be made by removing a horizontal end wire and reweaving through the ends of the fabric to form a continuous mesh. All top and bottom laps shall be made by folding the mesh to the outside, away from the slope, to avoid the possibility of falling material hanging up in the folds. The bottom of the mesh shall be located so that material dislodged under the mesh can drain freely from the bottom, yet will not flow or bounce onto the Roadway. The ends of all tie wires shall be secured to the mesh with a minimum of 1½-turns.

The wire mesh shall not be tensioned in any direction, but is to remain loose so as to increase its dampening effect on rolling rocks. The Contractor shall use care in the handling and installing of the wire mesh and wire rope. Any mesh or wire rope damaged due to the Contractor's operations shall be replaced by the Contractor at no expense to the Contracting Agency.

8-29.4 Measurement

Measurement of anchors will be per each for the completed anchor. Anchor types will not be differentiated.

Galvanized wire mesh will be measured by the square foot of the completed area.

Galvanized wire rope will be measured by the linear foot of wire rope actually used in the completed project.

8-29.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

“Wire Mesh Slope Protection Anchor”, per each.

“Galvanized Wire Mesh”, per square foot.

“Galvanized Wire Rope”, per linear foot.

